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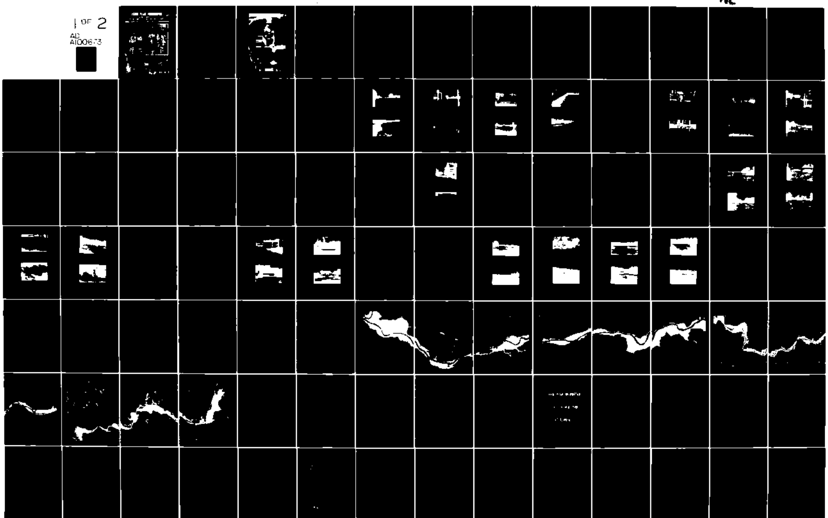
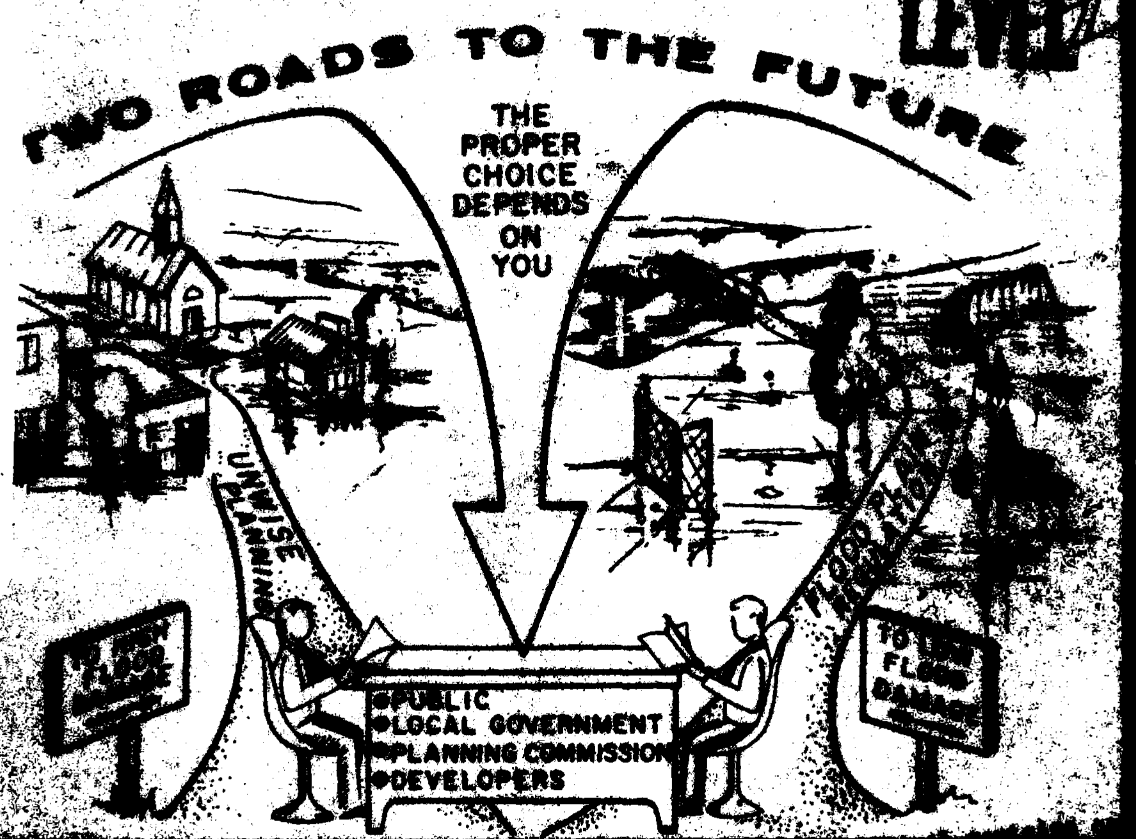


FLOOD PLAIN INFORMATION

BUFFALO CREEK

IN THE TOWNS OF ELMA AND WEST SENECA

MAIN REPORT AND TECHNICAL APPENDIX



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PREPARED FOR ERIE COUNTY
WITH COORDINATION OF
STATE OF NEW YORK WATER RESOURCES COMMISSION
AND DEPARTMENT OF PUBLIC WORKS

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REPORT DOCUMENTATION PAGE

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It is the intention of this study to provide useful and specific information on past flood occurrences as well as to provide a guide to the extent and frequency of future floods. With this information local and state agencies may work towards reducing future flood damages.

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Elma Methodist Church during March 1962 flood.

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FLOOD PLAIN INFORMATION

BUFFALO CREEK, NEW YORK

in the

TOWNS OF ELMA AND WEST SENECA

MAIN REPORT

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TECHNICAL APPENDIX

The technical appendix of this report was prepared in only a limited number of copies, principally for the use of engineers, designers and planners who have need for detailed

technical data. The general public is encouraged to use the reference copies of the appendix which will be available at the locations listed in paragraph 8. Included in the appendix is a list of pertinent bench marks for determining elevations in the flood plain, waterway openings for bridges in the study area, high water mark elevations and explanations of the methods used in deriving the data contained in the report.

PHOTOGRAPHS

PHOTOGRAPHS (Contd)

PHOTOGRAPHS (Contd)

SYLLABUS

The following report is directed primarily to two groups of people with an interest in the Buffalo Creek flood plain study area. First it is written to provide planners and local governments with technical information on the magnitude and frequency of possible future flooding along Buffalo Creek. With this information these planners and officials have a basis for effective and workable legislation for the control of land use within the flood plain.

The second group to whom the report is directed consists of the residents within the study area - particularly present and prospective property owners in and adjacent to the flood plain of Buffalo Creek. In order for flood plain regulations to receive the necessary public support, it is important that residents know the past history of flooding, the purposes and benefits of flood plain regulation and the ways that these regulations can be coordinated with an overall plan of development for the area. Often through ignorance of the flood problem or a disregard of the flood potential, expensive development is allowed to occur in flood plain areas. Federal funds for flood control projects are authorized only when there are sufficient damages from past floods to economically justify the cost of the project. This means that development in a flood plain area may suffer considerable damage before protection can be justified and the value of the original development is considerably reduced.

Regulation of flood plain development is a relatively new approach to the problem of preventing flood damages. It consists of first making the local residents aware of the magnitude and frequency of possible flooding. The flood plain areas of Buffalo Creek are relatively undeveloped and future damages can be held to a minimum by regulating the location and type of development. This report is designed to provide the general public with information concerning the flood potential and the local governments with data to form a basis for regulatory legislation.

Buffalo Creek has a history of a number of floods which inundated a substantial area. The fact that past damages and inconvenience have not been more severe is due to the relatively minor development in the flood plain area. Since there is every indication that the potential flood threat will increase, the only way to prevent an increase in damages is to prevent an increase in development in the flooded area. It must be understood that flood plain regulation will have but little effect on existing damages but is designed primarily to

prevent damages that would otherwise occur to future development. Nor does regulation preclude all development in the flood plain but rather recommends its use for recreation areas, parking lots, wild life refuges and other low damage developments.

A separate attachment containing a General Discussion of Guidelines for Flood Plain Regulations and Flood Proofing Practices has been included for those individuals and agencies who are interested in more details on these subjects than are contained in the main report. The attachment follows the main report and has been printed on green paper so that it can be more easily located.

FLOOD PLAIN INFORMATION REPORT

BUFFALO CREEK, NEW YORK

in the

TOWNS OF ELMA AND WEST SENECA

GENERAL

1. INTRODUCTION

The Flood Plain Information Report on Buffalo Creek, New York has been prepared at the request of the Erie County Department of Public Works. In New York State the Water Resources Commission is responsible for providing policy decisions concerning flood plain study applications and the Department of Public Works is responsible for coordination of the report preparation after the initiating policy decision has been made. By letter dated 21 November 1961, the New York State Department of Public Works requested the Corps of Engineers to consider the application for the Buffalo Creek study. The study covers approximately 17.8 miles of Buffalo Creek in the towns of West Seneca and Elma, Erie County, New York.

2. The report has been prepared in two parts - the main report and the technical appendix. The main report contains all the available pertinent information on the extent and frequency of flooding and was prepared for the general information and use of the public, local government officials, planning commissions, and developers. The technical appendix contains additional engineering details and technical data used or developed in the preparation of the main report, which may be of value to engineers and designers.

3. AUTHORIZATION

This report has been prepared under the provisions of Section 206, Public Law 86-645 (Flood Control Act of 1960), as amended, which authorizes the Corps of Engineers to compile and disseminate information on floods and flood damages upon the request of responsible local governmental agencies. The formal request for study was transmitted to the Chief of Engineers, Department of the Army, Washington, D. C., on 11 June 1962. This report has been reviewed and approved for release by the State of New York Department of Public Works and the Office, Chief of Engineers. Copies of pertinent

correspondence and the text of Section 206 are presented in the appendix to this report which has been printed in only a limited number of copies.

4. PURPOSE OF THE STUDY

It is the intention of this study to provide useful and specific information on past flood occurrences as well as to provide a guide to the extent and frequency of future floods. With this information, local and State agencies may work toward the achievement of the following objectives:

a. To publicize information for the guidance of public agencies, private interests and individual citizens on the hazards of flood plain occupancy.

b. To reduce future flood damage through regulation of the use of the flood plain.

c. To preserve adequate floodway and channel clearances.

d. To reduce future expenditures for projects to protect developments which, in the absence of this information, would have taken place.

e. To allow maximum use of the flood plain by developments with low damage potential, using the data from this study as the basis for local planning and regulation.

5. SCOPE OF THE STUDY

This flood plain information study covers the inundated areas along Buffalo Creek from its confluence with Cayuga Creek to the easterly limit of the town of Elma. For ready identification the upstream limit of the study has been taken as the East Aurora - Porterville Road bridge over the creek. The flood plain area includes portions of the towns of West Seneca and Elma in Erie County. The study area is indicated on plate 1 which is a basin map of Buffalo Creek. The study is intended to determine the extent and frequency of past flooding in the area and to provide an estimate of similar data for possible future occurrences.

6. Newspaper accounts, stream flow records and interviews with local residents indicate that recent flooding occurred within the study area in 1928, June 1937, March 1942, March 1955, March 1956, January 1959, and March 1962. Other floods probably occurred previous to 1928 but no definite dates or stages could be established because of the lack of development and records

in the area at that time. Because of its magnitude and recent occurrence, the most detailed information was obtained for the flood of January 1959. This flood was used as a reference for the information in this report. The flooded area from the January 1959 flood is shown on plates 2, 3, 4, and 5, and the profile for this flood is shown on plates 6 and 7.

7. USE OF THE REPORT

The information and suggestions contained in this study are presented for the information of the general public of the area and the consideration and use by the New York State Water Resources Commission, Erie County Planning Commission and other local government agencies. The flooded outlines, profiles and estimated flood frequencies can be used to determine the relative risk of flooding for various areas within the flood plain. With this information, future development, either on an individual lot or tract basis, may be planned with due regard for possible flooding both overland and through sewer outlets. When flood plain regulations are drawn up by local agencies they can be assisted by the general guidelines set forth in this report which recognize the need to permit optimum usage of an area without increasing potential flood damage. The flood outlines and profiles contained within this report provide a definite base to which these regulations can be related.

8. This study is not intended to extend any Federal authority over zoning or other regulatory methods, nor does it commit the Federal Government to investigating, planning, designing, constructing, operating or maintaining any facilities discussed or imply any attempt to undertake such activity if not authorized by Congress. It is the responsibility of the State and local agencies to disseminate the information in this report to local interests or individuals who have use for such information. The State coordinating agency for the distribution of this study is:

The New York State Water Resources Commission
Conservation Department
Albany, New York 12226

Copies of the main report or main report with technical appendix may be obtained by contacting the following local address:

State of New York Conservation Department
Division of Water Resources
4184 Seneca Street
West Seneca, New York

A limited number of copies will also be available for reference at the following locations:

a. Erie County Planning Department
2202 City Hall
Buffalo, New York 14202

b. Elma Town Hall
1410 Bowen Road
Elma, New York 14059

c. West Seneca Town Hall
4620 Seneca Street
West Seneca, New York 14224

Reference copies of the technical appendix will also be available for the use of the general public at the above locations.

9. ACKNOWLEDGMENTS

Considerable information was obtained from among the data developed for the Review of Reports for Flood Control and Allied Purposes on Cayuga, Buffalo and Cazenovia Creeks dated 1966. That report was also prepared by the Buffalo District, Corps of Engineers and contained much of the basic data necessary for this study. The cooperation and assistance given by the following agencies, and numerous individuals, in the accumulation of the information used in this report is greatly appreciated. A listing of credits for photographs follows the text of the report.

Town of Elma
Town of West Seneca
Erie County Department of Public Works
New York State Department of Public Works
Erie County Planning Board
U. S. Weather Bureau
U. S. Geological Survey
New York State Water Resources Commission

10. CONTINUING ASSISTANCE OF CORPS OF ENGINEERS

The technical assistance of the Corps of Engineers will be available to local and State agencies to interpret and explain the information contained in this report, particularly as to its use in developing effective flood plain regulations. After local authorities have selected the flood magnitude or frequency to be used as the basis for regulation, the Corps of Engineers can assist in the selection of floodway limits by providing

information on the effects of various widths of floodway on the profile of the selected flood. Requests for specific data that may be required in particular areas to carry out an effective regulatory control program should first be coordinated through the Water Resources Commission. As further information becomes available on rainfall, runoff and flooding, the Corps of Engineers can prepare addenda concerning any of the information that differs substantially from the data presented in this report. Major revisions should be specifically requested by the coordinating agency.

DESCRIPTION OF PROBLEM

11. GENERAL DESCRIPTION OF THE STUDY AREA

The Buffalo Creek flood plain study area lies within Erie County, New York. The lower 5.6 miles of the study area are within the town of West Seneca and the remaining 12.2 miles are within the town of Elma.

12. GENERAL DESCRIPTION OF THE WATERSHED

Buffalo Creek, which is shown on plate 1, is located primarily within Erie County but a portion of upper basin is in Wyoming County. The creek flows through the towns of Java, Shelden, Wales, Marilla, Elma, and West Seneca. Buffalo Creek has the largest drainage area of the tributaries which form the watershed of the Buffalo River. The two other major tributaries to Buffalo River are Cayuga Creek and Cazenovia Creek. Buffalo Creek rises in a fan-shaped tributary area in Wyoming County near Java, New York, on the north slope of the Allegheny Plateau. After the source tributaries join to form the main stream, the creek flows generally northwest to the confluence with Cayuga Creek. Hunter Creek, which joins the creek from the southwest at Wales Center, is the largest tributary. The watershed is long and narrow and has a total drainage area of only 150 square miles in the 43-mile length from the source to Cayuga Creek. Buffalo Creek flows westward another 2 miles to the confluence with Cazenovia Creek and then another 6 miles as Buffalo River to its mouth at Lake Erie. The flood plain is relatively narrow and well defined. Shale is evident in several locations in the steep valley walls which run along the creek for almost its entire length until its confluence with Cayuga Creek. Through the study area Buffalo Creek has a relatively steep average slope of 14 feet per mile. Rock is exposed in the channel bottom at several of the bridges.

13. LAND USE WITHIN THE FLOOD PLAIN

The flood plain is relatively undeveloped within the limits of the study as shown on plates 2, 3, 4, and 5. There are, however, three small communities which are occasionally affected by flooding: Gardenville in the town of West Seneca, and Blossom and Elma in the town of Elma. The affected development in these localities is principally residential with a total of about 20 homes and 6 commercial units subjected to damage in the past. Minor damage to farm buildings, equipment and crops, occurs throughout the length of the study area. Approximately 1,000 acres of agricultural and idle land are within the 1959 flood limits. The New York Central Railroad and several New York State highways cross the creek but the roads which parallel the creek are above the usual flood levels.

14. PROSPECTIVE DEVELOPMENTS AFFECTING THE FLOOD PLAIN

Although the Buffalo Creek watershed has so far remained relatively undeveloped, the increasing pressure of development moving outward from the metropolitan area will undoubtedly have a noticeable affect. No specific large scale developments are underway at the present time but plans have been submitted for approval for two subdivisions adjacent to the flood plain. The entire area is undergoing a gradual but definite increase in individual unit development. The population of both West Seneca and Elma have more than tripled since 1930 and nearly doubled between 1950 and 1960. Population in 1960 was approximately 33,000 in West Seneca and 7,500 in Elma. West Seneca has always been the more developed town and because of its close proximity to the city of Buffalo will be affected sooner by increasing development. The Aurora Expressway will give impetus to both residential and industrial growth in both towns. Water, sewer and gas are now available in West Seneca throughout the length of Buffalo Creek which enhances the possibility of development of existing vacant land. Water lines are being extended in Elma and as the utilities become more available development will increase rapidly.

15. As development occurs there are certain factors which affect flood flows and stages in the flood plain area. Increased development and population result in increased and faster runoff from roofs, parking lots, roadside ditches and storm sewers. Road bridges and creekside fills can, unless regulated, cause restrictions under conditions of high flow. If there is no compensating improvement in the carrying capacity of the natural channel, an increase in development can result only in increased discharges and flood elevations in the flood plain area. Since the flood plain is largely

undeveloped, the purpose of this report is to identify the flood plain and the frequency of flood stages so that future development can make the most effective use of the area without increasing present damages.

16. FLOOD WARNING AND FORECASTING SERVICES

At present there is no specific flood warning or forecasting service for the Buffalo Creek basin. The area, however, is well within the effective range of the Weather Surveillance Radar operating continuously at the U. S. Weather Bureau, Buffalo Airport Station. This equipment provides for the early detection and plotting of heavy precipitation and makes possible immediate radio and television broadcasts of information concerning the predicted path and amount of rainfall from the storm. The U. S. Weather Bureau has established flood forecasting systems for many of the larger river basins. Accurate forecasting of the timing and stages of flood peaks is difficult on a drainage area as small as Buffalo Creek.

17. At present there is no definite plan for flood fighting or evacuation in the Buffalo Creek basin. Coordination with other upstream communities such as Wales Center, Wales Hollow and Java Village would provide an indication of the timing and relative severity of a flooding situation. Reference points and staff gages could be located at one or more of these locations. A water stage recording gage is already established at Wales Hollow. Although the anticipated flood may be of moderate proportions, such forewarning permits public utilities, highway departments and property owners to set up warnings and detours and to reduce flood damage as much as possible. Staff gages that could be used for this purpose have been established by the Erie County Department of Public Works at Harlem Road in West Seneca, Bowen Road at Elma, Two Rod Road in Marilla and at Creek Road in Wales.

18. NATURE AND EXTENT OF FLOOD PROBLEMS

The greatest flood of historical record occurred in June 1937, and other damaging discharges occurred in 1928, March 1942, March 1955, March 1956, January 1959, and March 1962. Most of the winter and spring floods have been complicated by ice jams so that resulting flood stages are higher than they would be from discharge alone. A condensation of available information on the most notable floods is given in the following paragraphs. This information is given as an example of the type and extent of flood problems which

have already occurred and an indication of possible future flood problems. Because of the relatively light development along Buffalo Creek, data on high water marks and damages are not readily available except in the reaches through the communities of Gardenville, Blossom and Elma. Because of the effects of ice jams along the creek, maximum damages did not occur from the same flood at all three locations. Damages from a recurrence of these floods are tabulated in table 1, following the descriptions. Some damage to agricultural land from erosion and deposition occurred in each of the floods even though a monetary value was not available. Although it is known that floods occurred in the summer of 1928 and March 1942, no specific data are available. Exhibits 1 and 2 show flooding which occurred during these floods.

a. June 1937

This flood is generally considered to be the maximum of record and is the only one of the more notable floods to occur during the summer months. Heavy rainfall was recorded throughout the Western New York area on 17 June and again during 20-21 June. The rainfall of 20-21 June was centered in the eastern suburbs of Buffalo and fell on wet ground in a period of about 6 hours. The maximum rainfalls recorded for this period were 3.00 inches at the Buffalo Airport, 2.06 inches at the downtown Buffalo station and approximately 1.50 inches at South Wales. No observations of rainfall are available for the Buffalo Creek watershed. The few high water marks obtained indicate that the June 1937 storm caused the highest water levels along the creek for open channel conditions. Damages were estimated at the time of the flood to be approximately $7,500 along Buffalo Creek. These were primarily agricultural damages and were largely due to erosion.

b. March 1955

On 1 March 1955 flash floods occurred when heavy rain and thundershowers fell on frozen ground during a six-hour period. Average precipitation over the Buffalo Creek drainage area was 2.1 inches. Runoff from this storm produced the largest discharge of record at Gardenville gage. Pictures of some of the flooded areas are shown on exhibits 3 and 4.

c. March 1956

Precipitation occurred over Western New York State on 5 March from a low pressure system over the area and then on 6 March heavy rainfall occurred during thunderstorm activity. This precipitation was augmented by melting snow and the runoff was intensified by frozen ground. Precipitation averaged 1.9 inches over the Buffalo Creek basin and produced the same discharge at Gardenville as the March 1955 flood.

Photo No. 1. Looking downstream at temporary bridge used during construction of Union Road bridge during the flood of the summer of 1928.

Photo No. 2. Looking north across creek from Indian Church Road toward the N.Y.C. R.R. bridge during the March 1942 flood.

Photo No. 3. Looking north toward Clinton Street from Island Park at Gardenville, during the March 1942 flood.

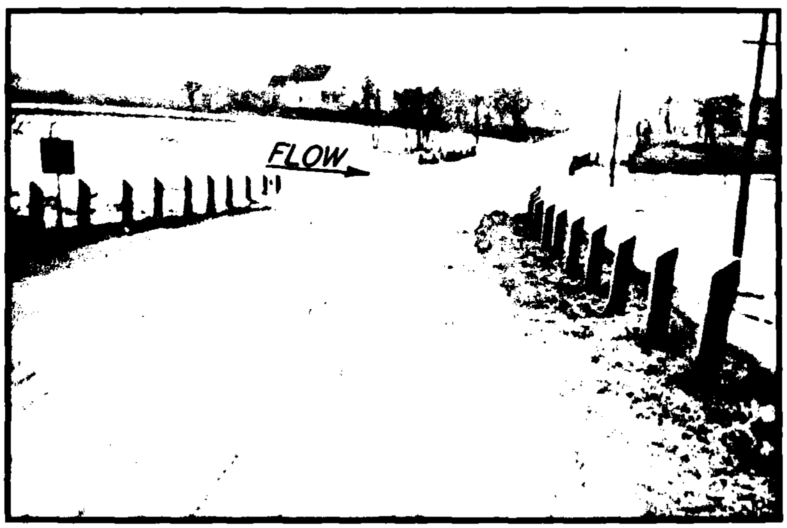

Photo No. 4. Looking south along Borden Road from bridge during the March 1942 flood.

Photo No. 5. Looking upstream from Harlem Road Bridge at the flooded flats at the confluence of Buffalo and Cayuga Creeks during the March 1955 flood. Clinton Street is in the left background.

Photo No. 6. Looking north along Borden Road during the March 1955 flood. Although water is over the road the bridge, shown in the background, is not full. This is looking in the opposite direction from photos 4 and 5.

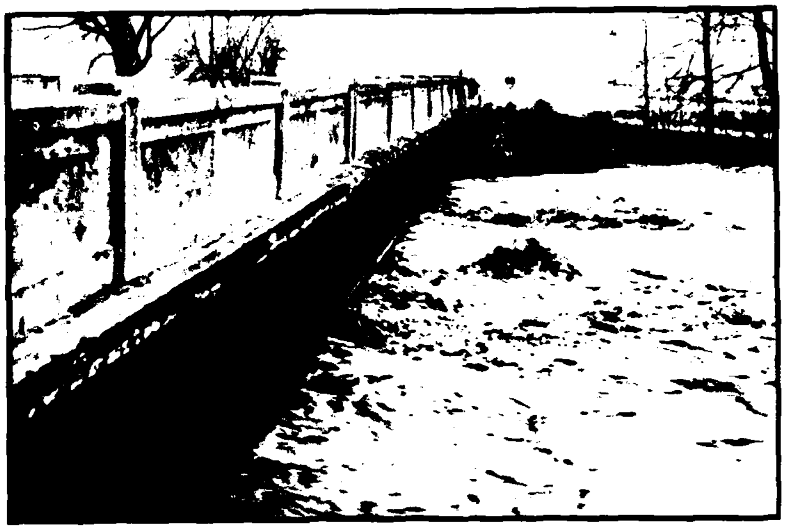

Photo No. 7. Looking south from the north abutment at the downstream side of the Transit Road bridge during the March 1955 flood.

Photo No. 8. Looking at upstream side of the N.Y.C. R.R. bridge from Indian Church Road. This flood took place during the 1950's.

d. January 1959

On 21 January 1959, a major storm system from the south central states brought heavy rainfall over Western New York. This precipitation was augmented by snowmelt from a heavy snow cover and the runoff was increased by the frozen ground. Flood conditions were further aggravated when the thick ice cover on the streams broke up during the rising water and caused numerous ice jams. Depth of water at a grove area upstream of Harlem Road is shown in exhibit 5. Although the 1959 discharge was less, ice jams at some locations created flood levels higher than those of 1955 or 1956. In Gardenville a 5-acre area on the left bank just downstream of Union Road was flooded. Damages occurred to ten residential and two commercial units from basement flooding. Flooding was not only from direct overflow from Buffalo Creek but from the overflow from a small constricted ditch on the left bank. Improvements have been made by the town of West Seneca to reduce flow into the ditch. Damages in the Gardenville area were $9,800. One business in Blossom also sustained minor damage. Two commercial units located on Bowen Road in Elma totaled about $800 in damage. The profile of the January 1959 highwater is shown on plates 6 and 7.

e. March 1962

In the town of Elma, along Bowen Road, twelve residential, three commercial, and four public units were affected by the March 1962 high water. Basements of the homes were flooded to a depth of about six feet and the basement of the old fire department building was flooded to a depth of about three feet. The new fire house and a church educational building were affected on the first floor. Total damages were approximately $4,900. Properties along Bowen Road were subject to relatively high velocities of flow as the flood waters left the banks upstream of the Elma dam and returned to the channel about one-half mile downstream. Although the discharge that caused the flood can be expected to occur, on the average, more than once a year, an ice jam in the vicinity of Bowen Road developed higher stages at Elma than other past floods. Examples of damage in Elma from the 1962 flood are shown on exhibits 6 and 7 and the frontispiece.

Photo No. 9. Ice lines indicate January 1959 flood elevation at Huppertz Grove, Collins Avenue. Near mile 0.15.

Photo No. 10. Same as photo no. 9. The January 1957 flood was 1.3' higher than the 1959 flood at this location.

Photo No. 11. Firemen shown pumping overland flood water out of basement at residence on Borden Road after water receded, during the March 1962 flood.

Photo No. 12. The new Elma Fire Hall during the March 1962 flood. The floor was covered by 8 inches of water.

Photo No. 13. Elma Methodist Church and Sunday School addition on Bowen Road, during the March 1962 flood.

Photo No. 14. Rear of Sunday School addition during the March 1962 flood. Addition now being used for regular school classes. The addition had 4 inches of water on the first floor.

TABLE 1. - Comparative data for floods of record

Flood	Elevation and stage at Gardenville gage	Peak discharge in cfs at Gardenville	Estimated damage for flood recurrence 1965 price levels and conditions			
			Gardenville	Blossom	Elma	Total
			$	$	$	$
Jun 1937	613.76 10.2 Est (1)	16,000 Est	16,000	1,000	4,800	21,[illegible]
[illegible] 1955	612.96 9.4	13,000	12,300	400	2,5[illegible]0	15,200
Mar 1956	612.96 9.4	13,000	12,300	400	2,500	15,200
Jan 1959	611.96 8.4	10,000	9,800	200	800	10,8[illegible]
Mar 1962	607.06 3.5	1,500	0	0	(2) 4,900	4,9[illegible]

(1) Gage installed Sep 1938.

(2) Ice jam.

19. EXISTING AND AUTHORIZED FLOOD CONTROL AND RELATED PROJECTS

The Cayuga, Buffalo and Cazenovia Creek watershed was studied in regard to flood control by the Buffalo District, Corps of Engineers in a Survey Report which was submitted to Congress on 23 July 1941. This report recommended a flood control project on Cayuga Creek in the village of Lancaster but found that flood protection elsewhere in the watershed was not justified. A review of the prior survey report was submitted to Congress by the Corps of Engineers on 7 November 1949. Although the report considered improvements for flood control along the lower reaches of all three creeks there was no feasible local protection project. Another review of the previous reports for flood control and allied purposes was completed in 1966 by the Buffalo District. This report recommended local flood control projects in the lower reaches of Cayuga and Cazenovia Creeks but no improvement plans could be justified for Buffalo Creek because most of the damages are scattered along the creek with no areas of large, concentrated damages.

20. In 1944 Congress authorized a program of farm-land treatment, and retirement and reforestation of submarginal land for the Buffalo Creek watershed, including Cayuga and Cazenovia Creeks. The program was started in 1946 as a joint project of the Soil Conservation Service of the Department of Agriculture and appropriate State and local agencies. The program was designed to treat farmland to reduce runoff and erosion and to stabilize stream banks to prevent their erosion. The principal land treatment methods have been farm ponds, tree planting, planting of retardation crops and strip cropping. The major conservation measures applied on the stream banks have been streambank protection, channel improvement, levees and water control structures. The general locations of the bank stabilization areas in the study reach are shown on plates 2, 3, 4 and 5. Although the Buffalo Creek flood prevention project was officially terminated on 31 December 1963, these conservation practices are continuing to be carried out by approximately 1,160 landowners in the total watershed of the three creeks. In the summer of 1963 Erie County excavated a channel in the rock channel bottom upstream of Winspear Road. The channel is approximately 18 feet wide d from 1.5 feet to 6 feet deep. The excavation begins about .0 feet upstream of Winspear Road and extends about 800 feet. The channel was designed to concentrate the flow in a narrow channel and reduce the amount of ice formed. A channel of this type may also develop some benefits from a betterment of fish habitat.

21. EXISTING REGULATIONS

Although zoning regulations have been in effect in the towns of West Seneca and Elma for a number of years, there are no specific provisions which regulate the use of land with respect to flood risk. The General Provisions of the Zoning Ordinance of West Seneca do indicate that the general goals of the ordinance include: "to secure safety from fire, flood, panic and other dangers." The State of New York enabling statutues which permit zoning, specify in Section 263 of the Town Law, that "such regulations shall be made in accordance with a comprehensive plan and designed to lessen congestion in the streets, to secure safety from fire, flood, panic and other dangers; to promote health and general welfare...." Also Section 277 concerning planning boards and official maps, states that "land shown on such plats shall be of such a character that it can be used safely for building purposes without danger to health or peril fr m fire, flood or other menace." The Rules and Regulations for the Approval of Subdivision Plans in the town of Elma provide in Section IV, Design Standards, Paragraph 3, Easements, Subparagraph 2:

"Where a subdivision is traversed by a water course, drainage way channel or stream, there shall be provided a storm water easement or drainage right-of-way conforming substantially with the lines of such water course, and such further width or construction, or both, as will be adequate for the purpose." Although this provides some control over subdivision developments near an existing stream, it apparently does not provide control over an individual builder.

22. The 1965 Legislature of New York State passed amendments adding Part IIIA, Use and Protection of Waters, to Article 5 of the conservation law. Part IIIA states, in part, that no person or public corporation shall change, modify or disturb the course, channel or bed of any stream or shall erect, reconstruct or repair any dam or impoundment structure without a permit from the Water Resources Commission. The amendments became effective on 1 January 1966. The full text of the Act can be found in Chapter 955, Section 429 a-g, of the Laws of New York State - 1965.

PRECIPITATION AND FLOODS

23. GENERAL

There is one existing climatological station within the Buffalo Creek watershed, at Wales, in the central portion of the basin. This station has been in operation since 1948 and records rainfall. Another station was in operation at Elma during the period 1942 and 1960. This station recorded rainfall, snowfall and temperature. The U. S. Weather Bureau has or does collect weather data at twelve stations which are nearby the Buffalo Creek basin and should provide average data for the area. The locations of these stations are shown on plate A1 in the appendix. A summary of the data from these stations is given in the following paragraphs along with a comparison of the data from Wales and Elma.

24. CLIMATOLOGY

The average annual precipitation for all the stations is 36.92 inches. The average for Wales is 36.48 inches, while that for Elma was 39.91 inches. The monthly averages range from a minimum of 2.53 inches in February to a maximum of 3.33 inches in May. The Wales station shows a minimum of 2.51 inches in February and a maximum of 3.39 inches in April. The same values for Elma were 2.79 inches in June and 3.95 inches in November. Rainfall over the basin is divided very

evenly between the months. The maximum recorded 24-hour rainfall was 4.28 inches, on 28-29 August 1893 at the station in downtown Buffalo. The storm of 7 August 1963 produced a total of 3.88 inches of rainfall which occurred within a period of about 5 hours at the Buffalo Airport station. The average annual snowfall for the area stations is 82.3 inches while the average for Elma was 97.3 inches per year. The average annual temperature for the area is 46.9 degrees Fahrenheit. January is the coldest month with an average of 24.2 degrees and July the warmest with 69.2 degrees. The record for Elma also showed an average of 46.9 degrees with an average of 24.8 degrees for January and 69.0 degrees for July.

25. STREAM FLOW RECORDS

Two stage recording gages are operated by the United States Geological Survey on Buffalo Creek. One station is in Gardenville on the left bank about 700 feet downstream of Union Road. The gage location is shown on plate 2. This gage was established in September 1938 and records the stages resulting from the runoff from the 145 square miles of watershed upstream of that point. The discharge rating curve for this site has been well defined by discharge measurements for open channel conditions. During winter and spring runoff conditions, the stage-discharge relationship is often affected by ice jams which sometimes make it difficult to determine the discharge during a particular flood. The rating curve for the site is given on plate A7 of the appendix.

26. The second stream gaging station is located near Wales Hollow on the right bank of the creek at the downstream side of the Merlau Road bridge. The gage is located approximately 23.5 miles upstream of the mouth of Buffalo Creek and about 6 miles upstream of the limits of this study. Wales Hollow is shown on plate 1. This gage was established in March 1963 and measures stages resulting from the runoff from an area of 80 square miles. The rating curve for this gage is not yet well defined because of its short record.

27. FLOOD FREQUENCIES

Floods are random occurrences dependent on a combination of natural climatological factors and channel conditions and there is no method of accurately predicting the time of occurrence or magnitude of any future flood event. However, an analysis of past flood events can give an indication of the probability of occurrence of a given stage or discharge.

28. In connection with flood damages and flood control planing, it is customary to estimate the frequency (or probability) with which specific flood stages or discharges may be equaled or exceeded rather than the frequency of an exact value of stage or discharge. Such estimates are properly designated as "exceedence frequency" but in practice are usually referred to simply as frequency. It must be realized that a so-called 50-year discharge does not imply a 50-year interval between discharges of that magnitude. What is meant is that in a long period of, say, 500 years, this discharge would probably be equaled or exceeded about 10 times, or on the average of once in 50 years. In other words, each year there is a two percent chance that a discharge or stage of at least that magnitude will occur.

29. Along Buffalo Creek, creek stages are regularly affected by ice jams. For this reason, a rather minor discharge can result in a major flood so that a stage-frequency relationship is considerably different from a discharge-frequency relationship for the same series of flood events. Frequency curves for both stages and discharges have been developed for reference points at Harlem Road, the U.S.G.S. gaging station downstream of Union Road, at the dam upstream of Seneca Creek Road at Blossom, at the dam upstream of Bowen Road at Elma, and at Jamison Road at East Elma. The locations of these points are shown on plates 2, 4, and 5. A discussion of the methods used to develop the frequency curves is presented in paragraphs A9-A12 of the appendix. The curves are shown on plates A4 and A6.

30. Discharge frequencies are affected by upstream development, additional storm sewers, changes in agricultural practices, etc. Stage frequencies are affected by ice jams, bridges, channel encroachments and other natural or unnatural restrictions. Since the frequency data developed for this report are based on a relatively few events, relationships shown should be reviewed periodically as more stage and discharge data become available. It is estimated that the effect of future development will produce an increase of about 2 percent in the 100-year discharge by 1980. Although this is not a sizable increase, it is apparent that over a period of time increases in development can produce a significant increase in discharge.

31. NEED FOR CONTINUING OBSERVATION

The flood profiles and frequency relationships presented in this report have been based both on past flood occurrences

and on accepted hydraulic design and hydrology techniques. While the results are considered adequate in regard to the general flood problems and conclusions, it should be emphasized that future data may indicate the need for further study in some localized areas. It is suggested that local interests continue to gather information on high water stages, particularly at the reference points used in this study. Comparative stages at existing high water marks would be helpful in future studies and planning. Data will continue to be available from the U.S.G.S. gaging stations. The Corps of Engineers will continue to analyze any pertinent data as they are obtained.

32. FLOOD PROFILES AND ESTIMATED LIMITS OF FLOODING

Because of the effects of ice jams, the maximum recorded stages along Buffalo Creek did not all occur from the same flood occurrence. The greatest amount of data throughout the study area was available on the flood in January 1959. The limit of flooding as it is estimated to have occurred is shown on plates 2, 3, 4, and 5. The water surface profile for the January 1959 flood is given on plates 6 and 7. Because this flood is of relatively frequent chance of occurrence, the estimated flood limits and profiles for a flood of 100-year frequency and the standard project flood are also shown. The standard project flood is the flood produced by the most severe flood-producing rainfall that is considered reasonably characteristic of the Buffalo Creek basin.

33. The limits of flooding and flood profiles are furnished to provide the local governments with a basis for flood plain regulation. The areas flooded by the January 1959 flood are those normally affected by flooding. The area inundated by the 100-year flood shows the additional effect of an infrequent flood. The area affected by the standard project flood is given to show the most severe flooding that can reasonably be expected to occur. A flood of this magnitude is so rare that a recurrence interval is not given. It must be understood, however, that the limits of flooding as shown are only approximate. Basement flooding from flooded sanitary sewer manholes may extend for a considerable distance beyond the limit of surface flooding. An example is shown on exhibit 8. The elevations from the profiles on plates 6 and 7 must be translated to the actual ground if an individual wishes to determine the depth of inundation at any given property. This can be done by using standard survey methods and one of the nearby bench marks or highwater marks described in the appendix. Storm sewer design should include the effects of high tailwater caused by flooding conditions. Whenever possible storm water

from high ground should be carried in a separate system from the storm water of the flood plain. This prevents additional water from affecting the low areas at times when the storm sewers are affected by high tailwater.

34. A tabulation of elevations and discharges which are estimated would result at the reference points from floods of several frequencies is given in table 2. Comparative stages from past floods are also given. In actual floods on Buffalo Creek, a stage having a particular frequency will, in most cases, not result from the discharge of the same frequency but will result from some lesser discharge complicated by ice jams.

35. HIGH WATER MARKS

A tabulation of the high water marks obtained throughout the study area for several of the past floods is given in table A7 of the appendix for the use of planners, engineers, contractors, and others concerned with flood elevations along Buffalo Creek. Approximate locations of the high water marks are shown on plates 2, 3, 4, and 5. If desired, profiles of future floods can easily be added to plates 6 and 7 by observation of peak levels during floods at the same locations as the high water marks already established. The new flood elevations can be determined by simply measuring up or down as the case may be, from the known high water mark elevations.

Photo No. 15. Homes on School Street near mile 2.25 which are affected by sewer backup when sanitary sewer manholes are covered.

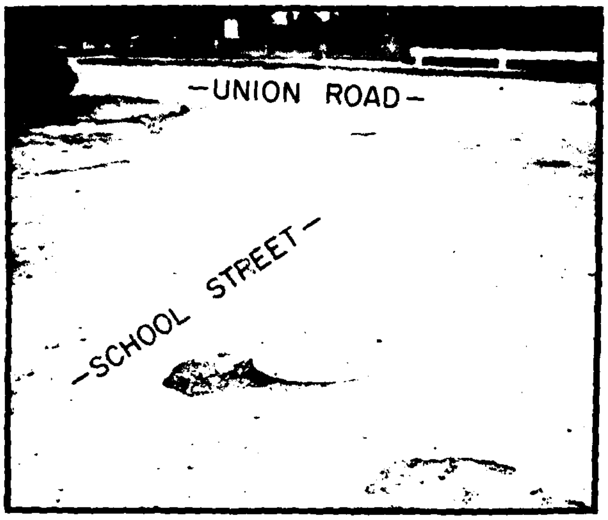

Photo No. 16. Manhole subject to surface flooding, about once in 5 years and causes basement flooding in the homes shown in photo no. 15. The homes would be subject to direct flooding about once in 20 years.

TABLE 2. - Estimated stages and discharges at the reference points for floods of several recurrence intervals

Reference point	Theoretical floods								Actual floods			
	10-year		50-year		100-year		Standard project		Jan. 1959		Mar. 1962	
	(1) Disch. cfs	(2) Stage ft.	(1) Disch. cfs	(2) Stage ft.	(1) Disch. cfs	(2) Stage ft.	Disch. cfs	Stage ft.	Disch. cfs	Stage ft.	Disch. cfs	Stage ft.
Harlem Road	19,000	591.3	24,000	593.6	26,000	594.5		597.0	16,500	591.5	4,900	583.0
U.S.G.S. gage	12,000	614.5	14,500	615.7	16,000	616.0	76,000	621.0	10,000	612.0	3,060	608.4
Blossom dam		668.4		669.7		670.0		673.0		667.0		662.9
Elma dam		725.1		727.0		727.5		735.5		725.0		726.5(3)
Jamison Road	11,000	820.7	14,000	822.6	15,500	823.3		833.5	8,500	820.0	2,000	813.9

(1) Discharge frequency based on relationships shown on plate A4.

(2) Stage frequency based on relationships shown on plate A6.

(3) Elevation caused by ice jam.

All flood stage elevations are given in feet above mean sea level - U.S.C. & G.S. datum.

GUIDE LINES FOR THE USE OF THE FLOOD PLAIN AND FOR REDUCING FUTURE FLOOD DAMAGES

36. GENERAL

In spite of the relatively frequent flooding, the damages along Buffalo Creek have been minor because of the lack of extensive or concentrated development. The Buffalo Creek watershed has an abundance of available vacant land at the present time but is in the line of population movement from metropolitan Buffalo to the south and east. In spite of the history of minor flood damage the flood plain will probably remain attractive for residential and commercial development. Some control on either the development or the creek will be necessary to prevent a large increase in flood damages as future development increases.

37. Flood damages can be prevented or reduced by two basic approaches. Damages to existing development can be reduced by flood control. Broadly speaking, it consists of exercising control over the stream in time of flood. Dams and reservoirs can be used to store water to be released after the threat of flooding has passed. Channel improvements can be used to remove constrictions and improve flow characteristics so that future flood stages are reduced. Levees, dikes and flood walls can be constructed to confine the river to a definite course at stages which may be well above the adjacent flood plain. These methods are generally very costly and therefore are used in areas where floods are frequent and damages to existing development are heavy. Estimated average annual benefits from a considered flood control project must be at least equal to the estimated average annual costs of the considered project, including interest, amortization and maintenance. Studies have indicated that present damages along Buffalo Creek are not sufficient to justify a Federal flood control project.

38. Damages to future development can be prevented by flood plain management. This consists of exercising control over the land lying adjacent to the river that is subject to flooding. The need for flood plain planning along Buffalo Creek has been recognized by local interests before the flood plain is extensively developed. This flood plain information study can provide the data on which flood plain management can be based. Future damages in the study area can be reduced or eliminated, at little or no cost to the taxpayer, by the legislation of flood plain regulations which prevent developments of a type or in areas which would make them subject to damage. At the same time these regulations should encourage and promote the maximum effective use of the flood plain area by developments which sustain a minimum of damage.

39. Regulation of the flood plain can be carried out most effectively by a combination of several of the available methods - encroachment lines, zoning ordinances, subdivision regulations and modifications or additions to existing building codes. These methods will be described in more detail in subsequent paragraphs. However, it is not within the purpose of this report to recommend the specific technique to be used. Flood plain regulations are the right and responsibility of local governments and they must decide the most suitable and effective method for their area. The Erie County Planning Board has done considerable research into the present and projected growth in the several towns of the County in the areas of land use, population, economy, transportation and recreation. Both West Seneca and Elma have town planning boards. Using the flood data in this report, in conjunction with a definite planning program for future land uses, will enable these and other local interests to permit maximum flood plain use consistent with minimum flood damage risk.

40. FLOOD PLAIN REGULATIONS

Flood plain regulation involves the establishment of legal tools with which to control the extent and type of development which will be allowed to take place within the flood plain. The regulatory controls have the broad purposes of (1) protecting existing development in the flood plain from additional damage by the control of activities which would increase existing flood stages and frequencies, and (2) controlling future development in areas where potential flood hazards are known to exist. For these controls to be effective, it is necessary that there be public understanding of the general problem, degree of risk, and alternative actions. Without such understanding, regulatory controls may be ignored, challenged in the courts and generally ineffective. Unrealistic ordinances are sometimes cast aside because no clear distinction has been made between the right to use one's property at his own discretion and the obligation of each individual to act in accordance with the general public welfare. The regulations must also be specific enough so that a prospective developer knows what established floor elevations, types of construction or encroachment limits are pertinent to the area in question. Finally, it should be emphasized that any flood plain regulations are only as effective as their administration and enforcement.

41. There are basically two main objectives of regulation. The first is to insure and guarantee the retention of an adequate floodway for the river. Floodway being defined as that area required to pass the selected regulatory flood without unduly raising upstream water surface elevations. The areas lying on either side of the floodway, and which may become inundated by this specific flood, are commonly called restrictive

zones. Although the restrictive zones may experience flooding, their areas are not necessary to carry the discharge of the flood, but rather serve as storage or backwater areas of low velocity. After the local agencies concerned have selected the magnitude or frequency of the flood which will be used as a basis for control legislation, the Corps of Engineers can provide the necessary technical assistance required to compare the effects of various widths of floodway on the profile of the selected flood.

42. There are several natural and man-made sections along Buffalo Creek which have an effect on water surface elevations during high discharge periods. Consideration should be given to modifying the condition whenever possible, removing the restrictive structure when it has outlived its usefulness, or replacing with a less restrictive structure when replacement becomes necessary.

43. Comparative openings of the bridges over Buffalo Creek within the study area are given in table 9A of the appendix. The profile for the 1959 flood, shown on plates 6 and 7, indicates that there may be constrictions at Union Road, Transit Road, Seneca Creek Road and Girdle Road. Pictures of several of the bridges are shown on exhibits 9 and 10.

44. At the present time there are dams at Blossom and Elma which are no longer in use and which project 3 to 4 feet above the natural creek bottom. Shoal areas have formed at the upstream end of the pools and ice floes and debris are easily grounded. If these dams are not serving any useful purpose removing them would reduce high water elevations in the immediate area. Pictures of the Blossom and Elma dams are shown on exhibits 11 and 12. Picture 21 shows the increase in water surface at the Blossom dam during a moderate runoff. Picture 22 shows that equipment has been engaged in removing shoal material from upstream of the Blossom dam.

45. There are some abrupt bends in Buffalo Creek, several of which probably contribute to ice jams and high water stages in the area. These bends can be easily located on plates 2, 3, 4, and 5. Two of the worst bends are located at mile 7.2 just downstream of Winspear Road and at mile 12.0 just upstream of Girdle Road. These bends have been produced by nature and reduction of the bends would be difficult. However, any man-made modifications to the flood plain, which tends to increase the sharpness of these bends or restrict the channel, should be avoided. A major bend which existed at approximately mile 0.7 was eliminated during the improvements made by the Soil Conservation Service.

Photo No. 17. Looking downstream at the New York Central R. R. bridge. Note the shoal upstream of the center pier.

Photo No. 18. Looking downstream at Union Road bridge showing rock in right bank and channel bottom. The wall and building on left bank indicate encroachment of the creek channel.

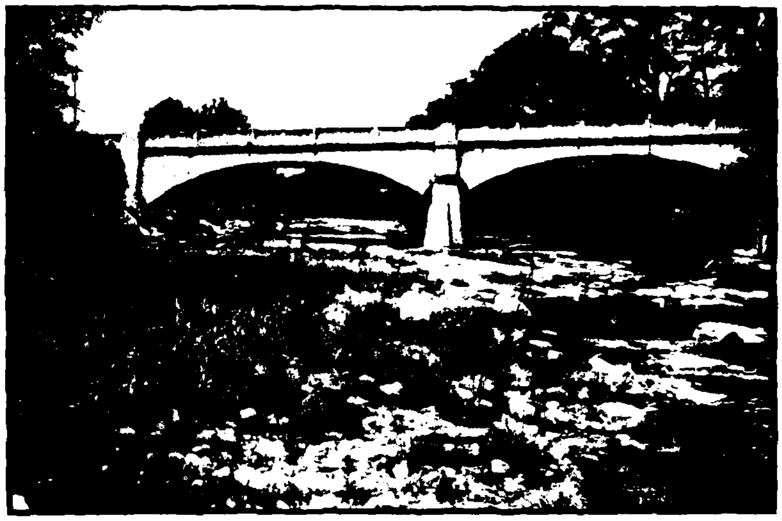

Photo No. 19. Looking downstream at Borden Road bridge showing rock channel bottom and shoals.

Photo No. 20. Looking downstream at Transit Road bridge showing the rock channel bottom.

Photo No. 21. Blossom Dam near mile 5.95. Photo shows increase in water surface at the dam during the moderate runoff of April 1959.

Photo No. 22. Looking upstream from Blossom Dam. Photo shows removal of gravel bar at upper left and shows riprap on bank at upper right which was placed by the Soil Conservation Service.

Photo No. 23. Elma Dam upstream of Bowen Road near mile 10.2. Note shale on right bank upstream of the dam.

Photo No. 24. Looking along crest of Elma Dam.

46. The second objective of regulation is to encourage sound land use within these restrictive zones, consistent with the flood hazard and the community land use needs. The flood profiles on plates 6 and 7 are the basis for this aspect of regulation. For example, if local planners decide that future residential development should be protected from elevations a specific number of feet higher than the January 1959 flood, regulations should be based on that profile. Building codes, subdivision regulations or zoning ordinances should specify the minimum allowable elevation for first floor, basement slab, or building site (whichever is selected). The minimum allowable elevations should be given in terms of a specified distance above the January 1959 profile at the nearest point to the construction site - the January 1959 profile being defined by the profile and high water marks contained in this report. The January 1959 flood stages have a frequency of about once in 10 years. At least two new buildings have been constructed recently in the flood plain at Elma. The new Fire Hall, shown in picture 25 of exhibit 13, had 8 inches of water over the floor in March 1962 which was about 1 foot higher than January 1959. The new school addition to the Methodist Church, shown in picture 26 of exhibit 13, was affected by 4 inches of water in the 1962 flood. The following paragraphs include references to examples of flood plain regulation that already exist within the flood plain area of Buffalo Creek. A more complete discussion of the methods of establishing flood plain use is contained in the attachment which follows the main report.

47. Both West Seneca and Elma have existing zoning ordinances. The Town of Elma adopted the original ordinance in 1950 and it has been revised several times. The latest revisions are under consideration at the present time. The Town of West Seneca adopted its present ordinance in 1964. Both towns also have a section within the zoning ordinance which deals with a building code. Although there is presently no regulation requiring it, one resident downstream of Winspear Road in Elma has raised his home approximately 5 feet to reduce the periodic flood damage. This is shown in picture 27 of exhibit 14. A supermarket has been constructed on fill within the flood plain area upstream of Harlem Road on the left bank. Picture 28 of exhibit 14 indicates that, in spite of the filling, this valuable property is still subject to flooding by a recurrence of the 1957 flood in that area.

48. The Town of Elma already has adopted Rules and Regulations for the Approval of Subdivision Plans. These regulations were adopted in 1955 and revised in 1959. The paragraph from the Subdivision Regulations dealing with the provision for any natural water courses through proposed subdivisions has been

quoted in paragraph 21. At the present time there are no subdivision developments within the flood plain area of Buffalo Creek although several applications have been made for areas which are adjacent to the flood plain in West Seneca. There are several areas which are attractive as subdivision sites during dry weather but which are inundated during high flows. Pictures of two of these areas are shown in exhibit 15.

49. REDUCTION OF FLOOD LOSSES BY FLOOD PROOFING

In addition to flood plain regulations for future developments there are several methods of flood proofing structures which may be helpful to those persons who are already located in the flood plain. Flood proofing is the use of structural modifications and adjustments to property for the purpose of reducing flood damages. It is most often carried out on an individual basis and is generally not a part of an enforced flood plain regulation program. Residents in the Gardenville, Blossom and Elma areas may be particularly interested in this phase of flood damage reduction since some of them have already suffered damage several times. A description of several flood proofing methods and an illustrative exhibit are included in the separate attachment following the main report.

50. RECREATIONAL LAND NEEDS

In 1960 an Erie-Niagara Regional Plan was developed through the coordinated efforts of the Erie County Planning Department and the Niagara County Planning Board. Section V of this Regional Plan, Outdoor Public Recreation, provides a review of the existing recreational facilities of the region, some criteria and standards for recreational areas and a prediction of recreational land needs for the future. The recreation report states that the oldest and most widely accepted guide for recreation acreage is the rule-of-thumb of one acre per 100 persons. Based on a probable future regional population of 2,100,000 for the year 2000, recreational requirements would be 21,000 acres. The Erie-Niagara Region had approximately 4,900 acres of park land in 1960. The 1960 population for the region was about 1,300,000 which means that there should have been more than 8,000 additional acres of park land available at that time to meet the needs of the existing population.

51. Included within these recreational land requirements can be many areas which need little or no formal development. Existing flood plain lands can be easily utilized for hiking, picnicking, nature trails, overnight camping, etc., with a negligible increase in damage potential. State assistance for land acquisition is available under a $100,000,000 bond

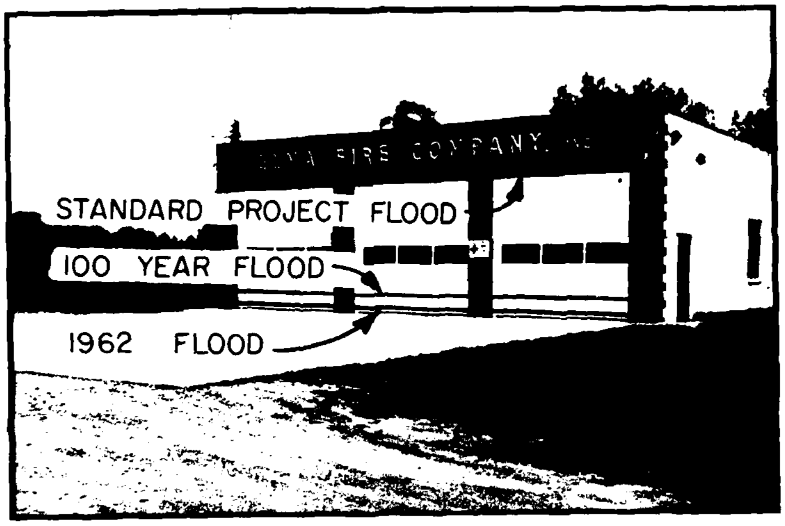

Photo No. 25. Elma Fire Hall built in 1959. Showing comparative flood levels.

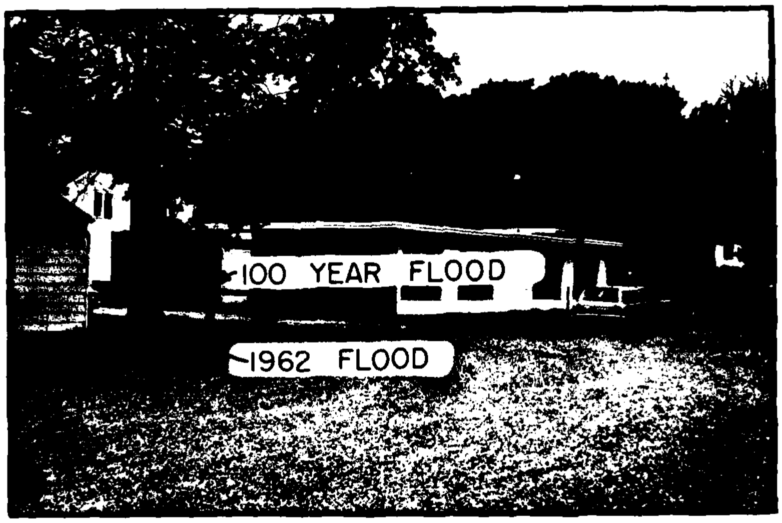

Photo No. 26. Sunday School addition to Elma Methodist Church. Showing comparative flood levels. Standard Project Flood elevation would be above roof.

Photo No. 27. Home on Winspear Road near mile 7.4, raised 5 feet in 1963. Dashed line on house indicates March 1962 flood level before house was raised.

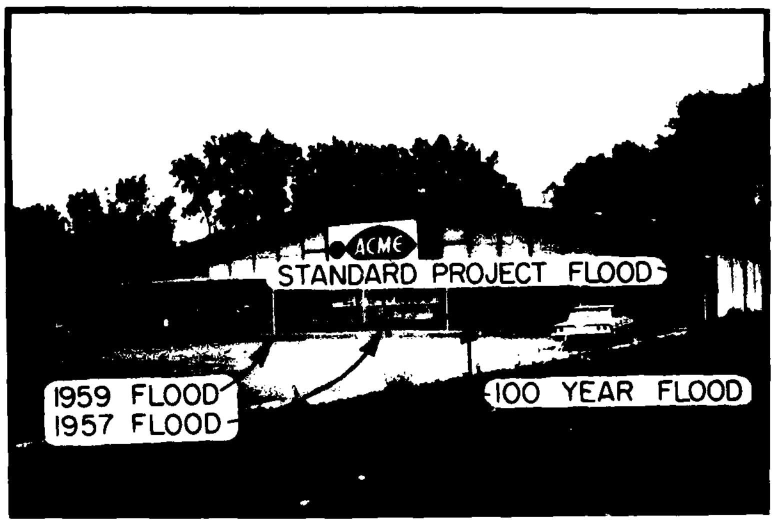

Photo No. 28. Supermarket on Harlem Road in the flood plain. The horizontal lines indicate the comparative levels of several floods.

issue program. A 820-acre site on Hunter's Creek, a tributary of Buffalo Creek upstream of the study area, is included in plans for future recreational development. The master development plans for West Seneca and Elma provide for a good skeleton of parks and greenbelt areas along Buffalo Creek. Island Park, a privately owned grove area, is located at Gardenville on the left bank just upstream of Union Road. There are several recreation areas in the town of Elma that utilize a portion of the flood plain. The athletic field for the Iroquois Central School extends into the flood plain area on the left bank just upstream of Bullis Road near stream mile 13.2. The Elma Meadows Country Park has golf course facilities in the flood plain area near mile 14.3 on the left bank. Opposite of this point, the Elma Conservation Club has developed rifle range facilities and the town of Elma has developed picnic and athletic facilities in Centennial Park. All of these areas provide evidence of good flood plain usage and indicate that although use of the flooded area is restricted, a non-damaging use can often be coordinated with a more valuable development on adjacent high ground. Pictures of these developments are shown on exhibits 16 thru 18.

52. POSSIBLE DIRECT FLOOD CONTROL MEASURES

Because of the relatively minor development within the flood plain area of Buffalo Creek, flood damages throughout the whole area have been relatively light, although some individuals have suffered serious damage. Corps of Engineers studies concluded in 1966 indicated that no improvement plans based on providing adequate protection could be economically justified on Buffalo Creek. A review of problem areas by local interests may show that some minor improvement may provide a substantial amount of benefit to the immediate area even though occasional flooding could still occur.

53. CONCLUSIONS

The Erie County Planning Department and the planning boards of West Seneca and Elma are aware of the problems of the flood plain. Studies have been made through the Erie County Planning Department on present economic and population growth trends and the resulting needs for housing, recreation facilities, schools, utilities, and transportation. The population of Erie County is expected to be 25 percent greater in 1980 than it was in 1960. West Seneca, which is in the first suburban ring around Buffalo, should experience an increase of more than 40 percent by 1980 over the 1960 population of 33,000. Elma, in the second suburban ring, is expected to

experience a growth of more than 100 percent over its 1960 population of 7,500. As a result the Buffalo Creek area will be subjected to increasing pressures for development and without adequate regulation some of this development would undoubtedly occur in areas subject to flooding. The comprehensive plans for development in West Seneca and Elma both provide for the establishment of green belt areas along Buffalo Creek. Carrying out these considerations would provide for much needed recreation areas and hold future damages to a minimum.

54. Damages that would accrue to unrestricted future development in the flood plain can be prevented by regulatory controls. These regulatory controls should provide for the optimum use of the area with the minimum risk of flood damage. The flood outlines and profiles contained with this report provide a definite base to which these regulations can be related. Public awareness of the potential floods and public acceptance and backing of the flood plain regulations can prevent any significant rise in the existing damage potential with little direct cost to the area. This awareness may also serve to reduce damage in the existing development through flood proofing of existing structures and by reducing existing channel restrictions by providing more adequate bridge areas, removal of dams, etc., when the existing structures have exceeded their useful life.

Photo No. 29. Desirable area for development upstream of Borden Road which lies within the flood plain. This is the same area as shown in photo 4, exhibit 2.

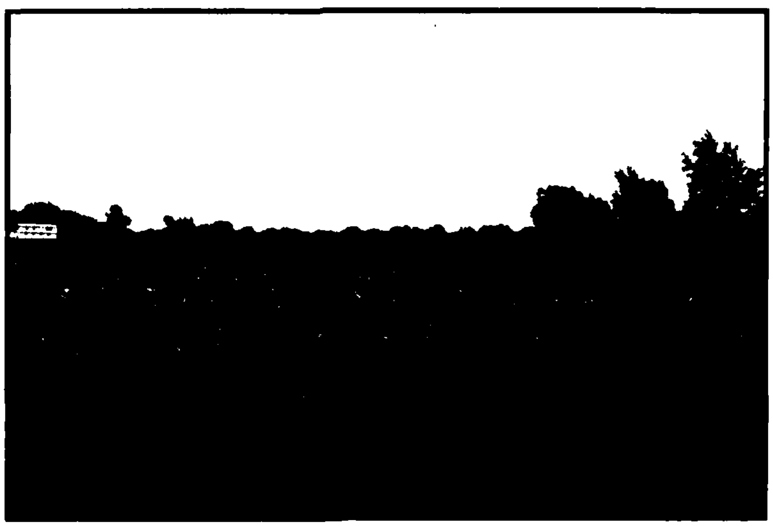

Photo No. 30. Desirable area for development upstream of Transit Road which lies within the flood plain.

Photo No. 31. Island Park at Gardenville near mile 2.3. This area was flooded by about 2 feet of water in the 1955 and 1956 floods.

Photo No. 32. Athletic field of Iroquois Central School off Bullis Road near mile 13.2. This area is higher than all but the infrequent floods, although it would be relatively undamaged even by frequent flooding.

Photo No. 33. Elma Meadows County Park near mile 14.3. The building is above flood levels but lower portions of the golf course are flooded.

Photo No. 34. Elma Conservation Club near mile 14.8. Although the club house is high, the property near the creek is subject to flooding.

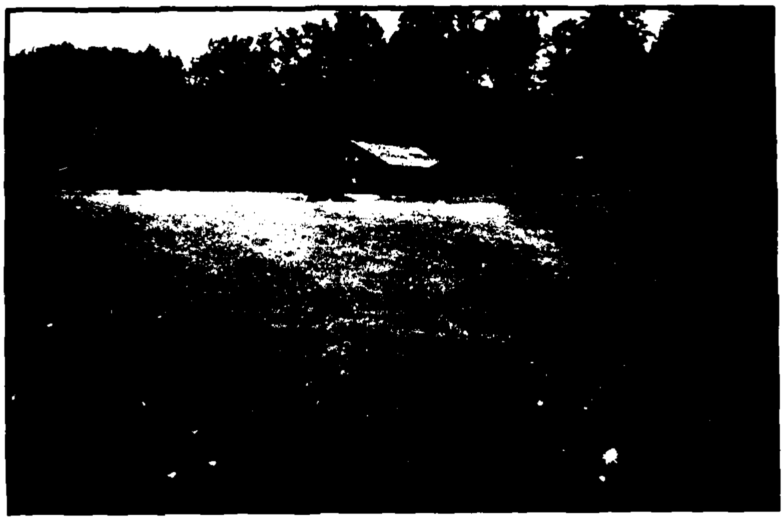

Photo No. 35. Town of Elma Centennial Grove near mile 14.6. This area is higher than all but extreme flood elevations. These types of improvement are not subject to significant damages from flood occurrences.

Photo No. 36. Town of Elma athletic field near mile 14.7. This area is above the normal flood level but would not suffer serious damage under flood conditions.

EXHIBIT 18

PHOTO CREDITS

Frontispiece - Buffalo Evening News

Nos. 1, 2, 3, 4, 7, 8	-	Historical Society of West Seneca
Nos. 5, 21	-	U. S. Dept. of Agriculture, Soil Conservation Service
No. 6	-	Mrs. Walter Mitzel
Nos. 9, 10	-	Mr. Walter Huppertz
Nos. 11, 12	-	Mrs. William F. Jasel
Nos. 13, 14	-	Mr. George Briggs
Nos. 15 through 20 22 through 36	-	Buffalo District, Corps of Engineers

GLOSSARY OF SELECTED TERMS

A. HYDROLOGIC TERMS

1. Channel - A natural or artificial watercourse of perceptible extent, with definite bed and banks to confine and conduct continuously or periodically flowing water.

2. Crest gage - A gage which leaves a record of the highest stage occurring during a particular flood. The gage usually consists of a hollow pipe anchored vertically in the stream channel. Flood water rising within the pipe leaves a mark at its highest elevation by means of crumbled cork or dye floating on the surface of the water within the pipe.

3. Discharge measurement - A method of determining the total discharge past a given point in a stream during actual flow conditions. The method requires the use of a velocity meter, and an accurate measurement of the cross sectional area of the flowing stream, from the stream bottom to the water surface. The most reliable rating curves are obtained by plotting measured discharge vs observed stage at the time of measurement over a wide range of flows.

4. Flood - A temporary rise in stream flow or stage that results in significant adverse effects in the vicinity under study.

5. Flood stage - A term commonly used by the U. S. Weather Bureau and others to designate that stage, on a fixed river gage, at which overflow of the natural banks of the stream begins to cause damage in any portion of the reach for which the gage is used as an index.

6. Flood frequency - A means of expressing the probability of flood occurrence. It is customary to estimate the frequency with which specific flood stages or discharges may be equaled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates are properly designated "exceedence frequency" but in practice are usually referred to simply as "frequency". The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years; or as a percent - the percentage being numerically equal to the average number of occurrences in 100 years.

7. Flood peak - The highest value of the stage or discharge attained by a flood; thus peak stage or peak discharge.

8. Flood of record - Any flood for which there is reasonably reliable data useful in technical analyses. Often the term is used to refer to "maximum flood of record."

9. Flood plain - The relatively flat low lands adjoining a watercourse or other body of water subject to overflow therefrom.

10. Flood profile - The longitudinal profile traced by the crest of a flood event expressed in elevation.

11. Gage - (See Recording and Staff gage).

12. Green belt - A term related to the development and retention of stream frontages and flood plains as "green belts." Permissive use of these public or private lands for certain agricultural uses, parks, golf courses, and similar uses would materially reduce or regulate the damage potential in the frequently affected portion of the flood plain area.

13. Historical flood - A known flood which occurred before systematic record keeping was begun for the stream or area under consideration.

14. Natural floodway - The channel of the stream or body of water and that portion of the flood plain that is used to carry the flow of the flood.

15. Rating curve - (See Stage-discharge curve).

16. Recording gage - Any gage which records stage heights continuously so that a permanent record is produced showing the river stage vs time. The mechanism usually consists of a drum revolving at constant speed and an inking pen whose movements are activated by the fluctuating river stage.

17. Recurrence interval - The average interval of time, based on a statistical analysis of the past record, which can be expected to elapse between floods equal to or greater than a specified stage or discharge. Recurrence interval is generally expressed in years.

18. Staff gage - A graduated scale anchored permanently in a vertical position within a stream channel, so that the height of the water surface can be read directly on the scale.

19. Stage-discharge curve - (Rating curve) A graph showing the relation between the gage height, usually plotted as ordinate, and the amount of water flowing expressed as volume per unit of time, usually cubic feet per second, plotted as abscissa. A rating curve is applicable only to the given location on the river for which it was developed.

20. Standard project flood - The flood produced by the most severe flood-producing rainfall that is considered reasonably characteristic of the drainage basin under study.

21. Thalweg - The elevation of the deepest part of a stream channel at any section. When determined at many sections along the length of a stream, it provides a profile of the bottom from mouth to source.

B. REGULATORY TERMS

1. Building code - A collection of regulations adopted by a local governing body setting forth standards for the construction of buildings and other structures for the purpose of protecting the health, safety and general welfare of the public.

2. Designated floodway - A channel of a stream and that portion of the adjoining flood plain designated by a regulatory agency to provide for reasonable passage of flood flows.

3. Encroachment lines - Lateral limits or lines along streams or other bodies of water, within which no structure or fill may be added. Their purposes are to preserve the flood carrying capacity of the stream or other body of water and its flood plain, and to assure attainment of the basic objective of improvement plans that may be considered or proposed. Their location, if along a stream, should be such that the floodway between them including the channel will handle a designated flood flow or condition. These lines are set by regulatory agencies and may be changed by them.

4. Flood plain regulations - A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land and construction within flood plain limits. The term encompasses zoning ordinances, sub-division regulation, building and housing codes, encroachment laws and open area regulations.

5. Flood proofing - A combination of structural changes and adjustments to properties subject to flooding primarily for the reduction or elimination of flood damages.

6. Selected regulatory flood - The magnitude of flood expressed either in discharge or frequency of occurrence, which is used as the basis for flood plain regulations.

7. Subdivision regulations - Regulations and standards established by a local public authority, generally the local

planning agency, with authority from a State enabling law for the subdivision of land in order to secure coordinated land development, including adequate building sites and land for vital community services and facilities such as streets, utilities, schools and parks.

8. Zoning ordinance - An ordinance adopted by a local governing body, with authority from a State zoning enabling law, which under the police power divides an entire local governmental area into districts and, within each district, regulates the use of land, the height, bulk, and use of buildings or other structures, and the density of population.

C. OTHER TERMS

Urban Renewal - The overall program of public and private action, growing out of the National Housing Act of 1954 as amended, designed to prevent the spread of blight, to rehabilitate and conserve urban areas that can be economically restored, and to clear and redevelop areas that cannot be saved.

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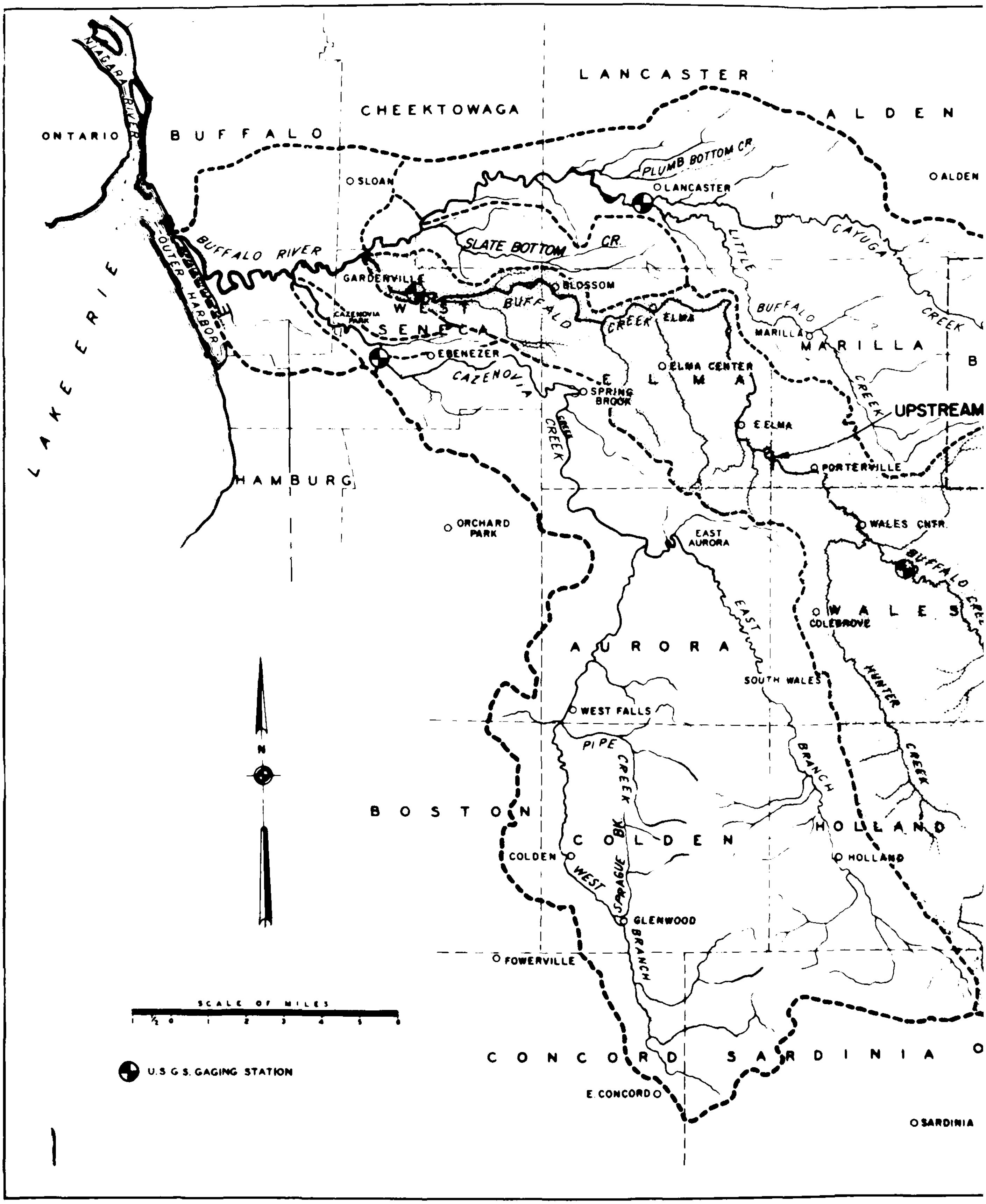
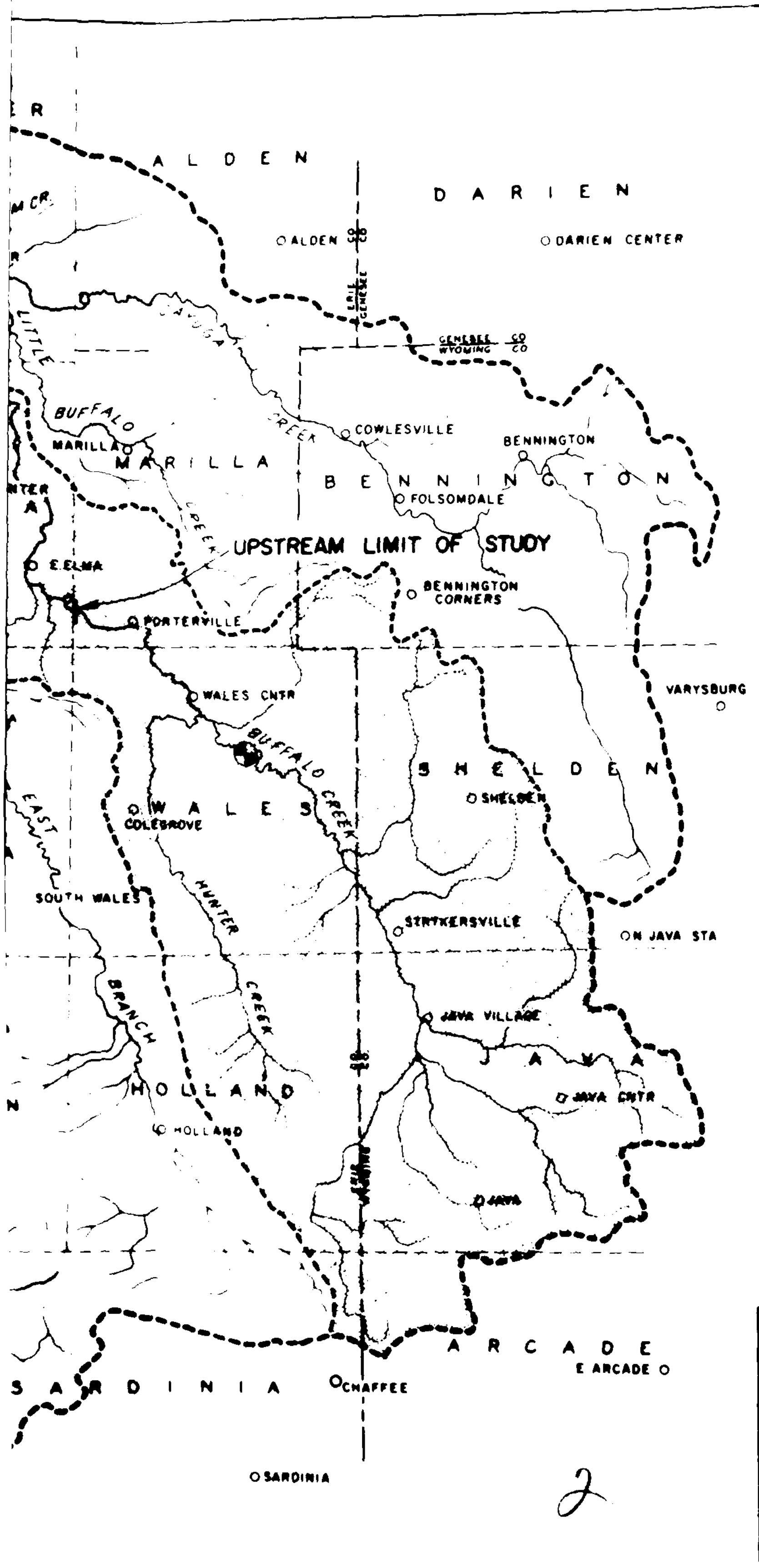
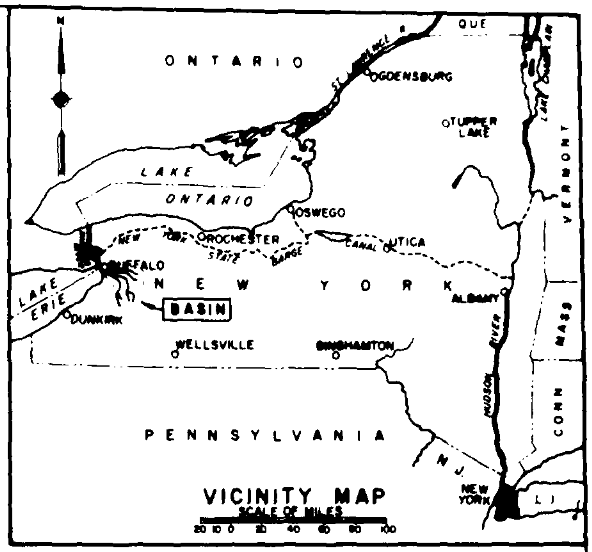


LANCASTER
CHEEKTOWAGA
ALDEN
ONTARIO
BUFFALO
NIAGARA RIVER
PLUMB BOTTOM CR.
SLOAN
LANCASTER
ALDEN
BUFFALO RIVER
SLATE BOTTOM CR.
LITTLE
CAYUGA
OUTER HARBOR
GARDENVILLE
BLOSSOM
WEST
BUFFALO
CAZENOVIA PARK
SENECA
CREEK
ELMA
BUFFALO
MARILLA
CREEK
MARILLA
LAKE ERIE
EBENEZER
CAZENOVIA
ELMA CENTER
ELMA
B
SPRING BROOK
CREEK
CREEK
E. ELMA
UPSTREAM
PORTERVILLE
HAMBURG
ORCHARD PARK
EAST AURORA
WALES CNTR.
BUFFALO CRE
EAST
WALES
COLEBROVE
AURORA
HUNTER
SOUTH WALES
WEST FALLS
PIPE
CREEK
BRANCH
CREEK
N
BOSTON
BK
COLDEN
HOLLAND
COLDEN
WEST
SPRAGUE
HOLLAND
GLENWOOD
FOWERVILLE
BRANCH
SCALE OF MILES
CONCORD
SARDINIA
U.S.G.S. GAGING STATION
E. CONCORD
SARDINIA





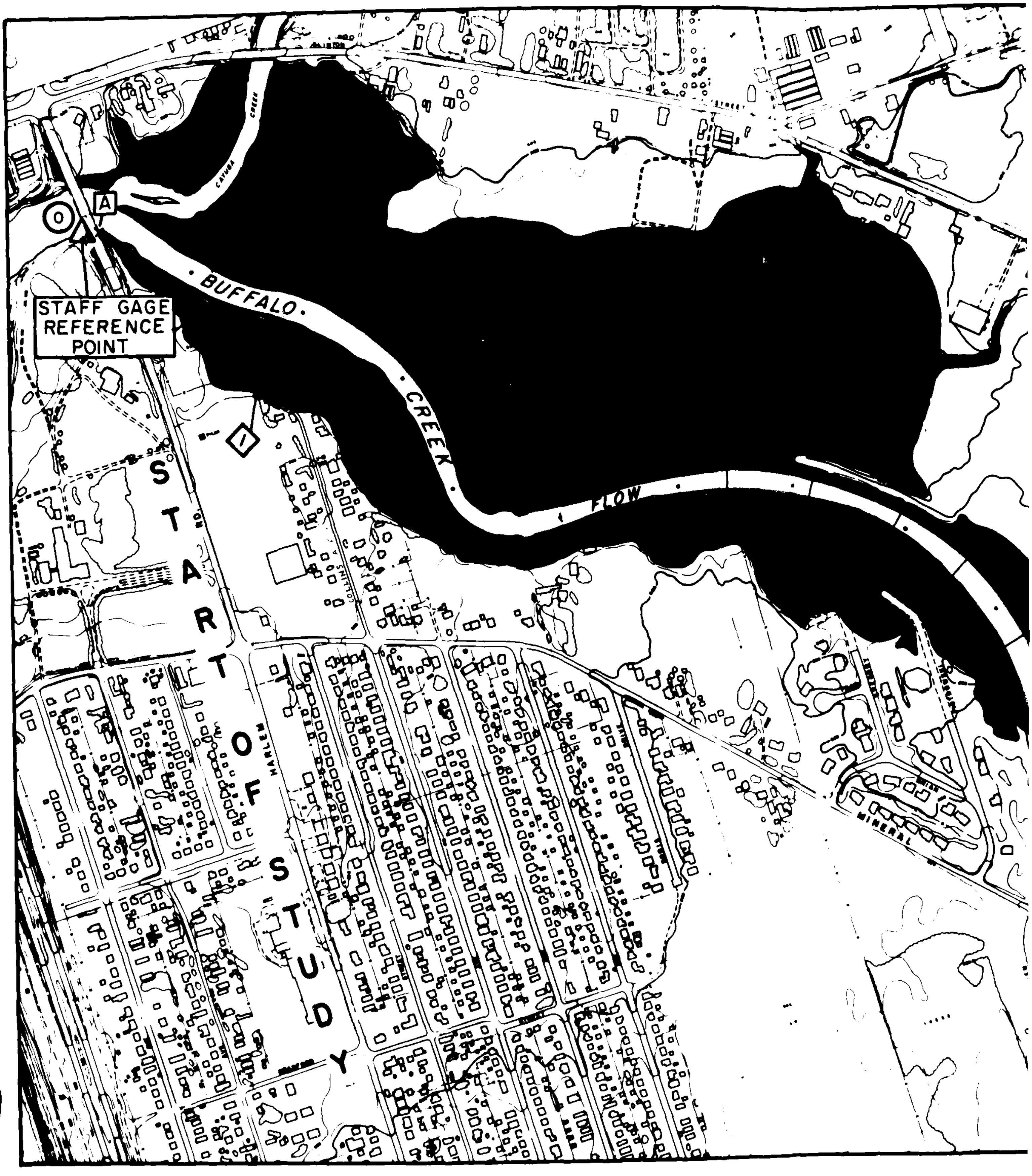
FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA

BASIN MAP

U. S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 1

2


STAFF GAGE
REFERENCE
POINT
A
O
1
BUFFALO CREEK
FLOW
START OF STUDY
CAYUGA CREEK
HARLEM
COLLINS
MINERAL

CLINTON STREET
NEW YORK CENTRAL R.R.
SPRINGS
CHURCH RD
1
2

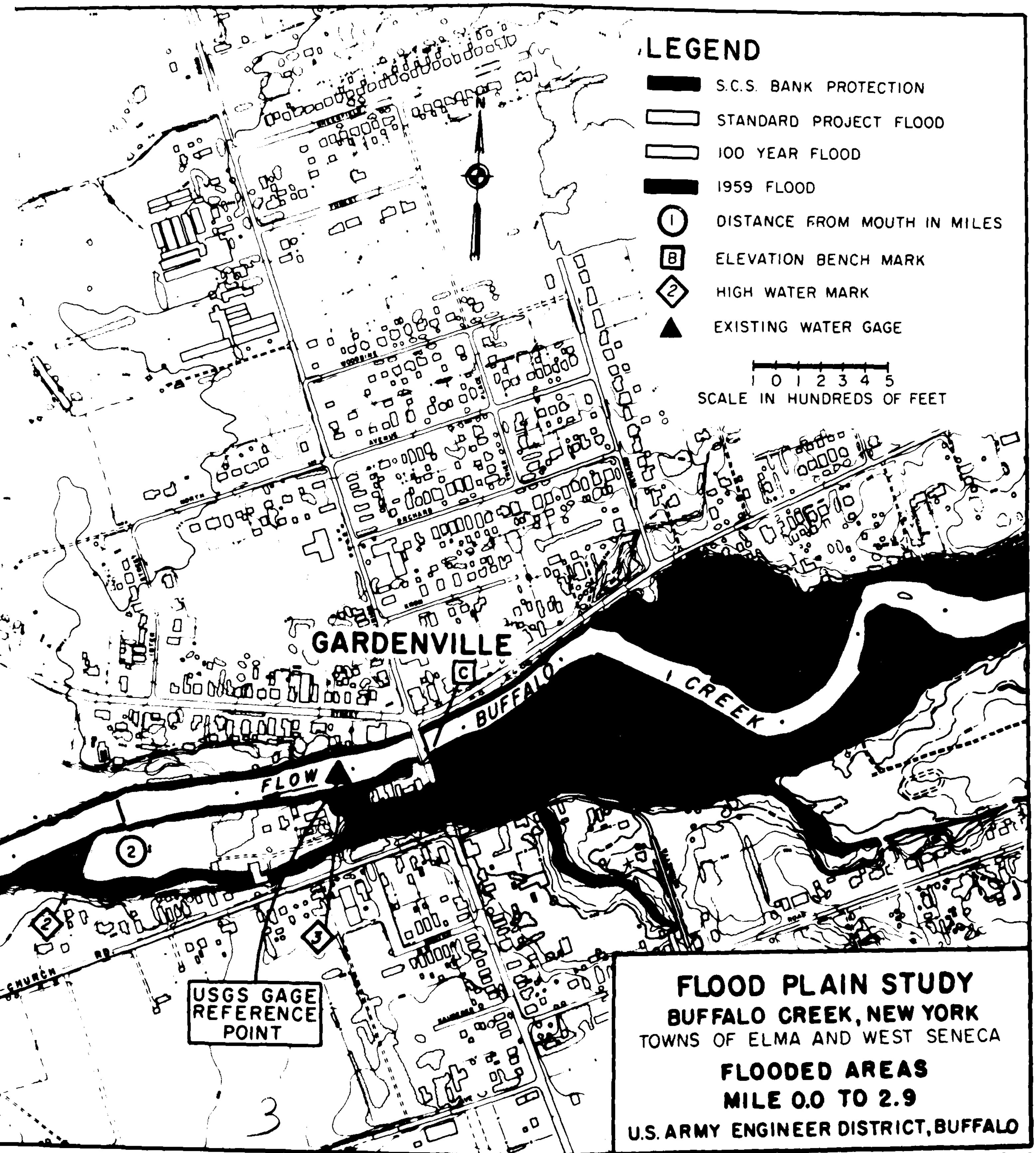
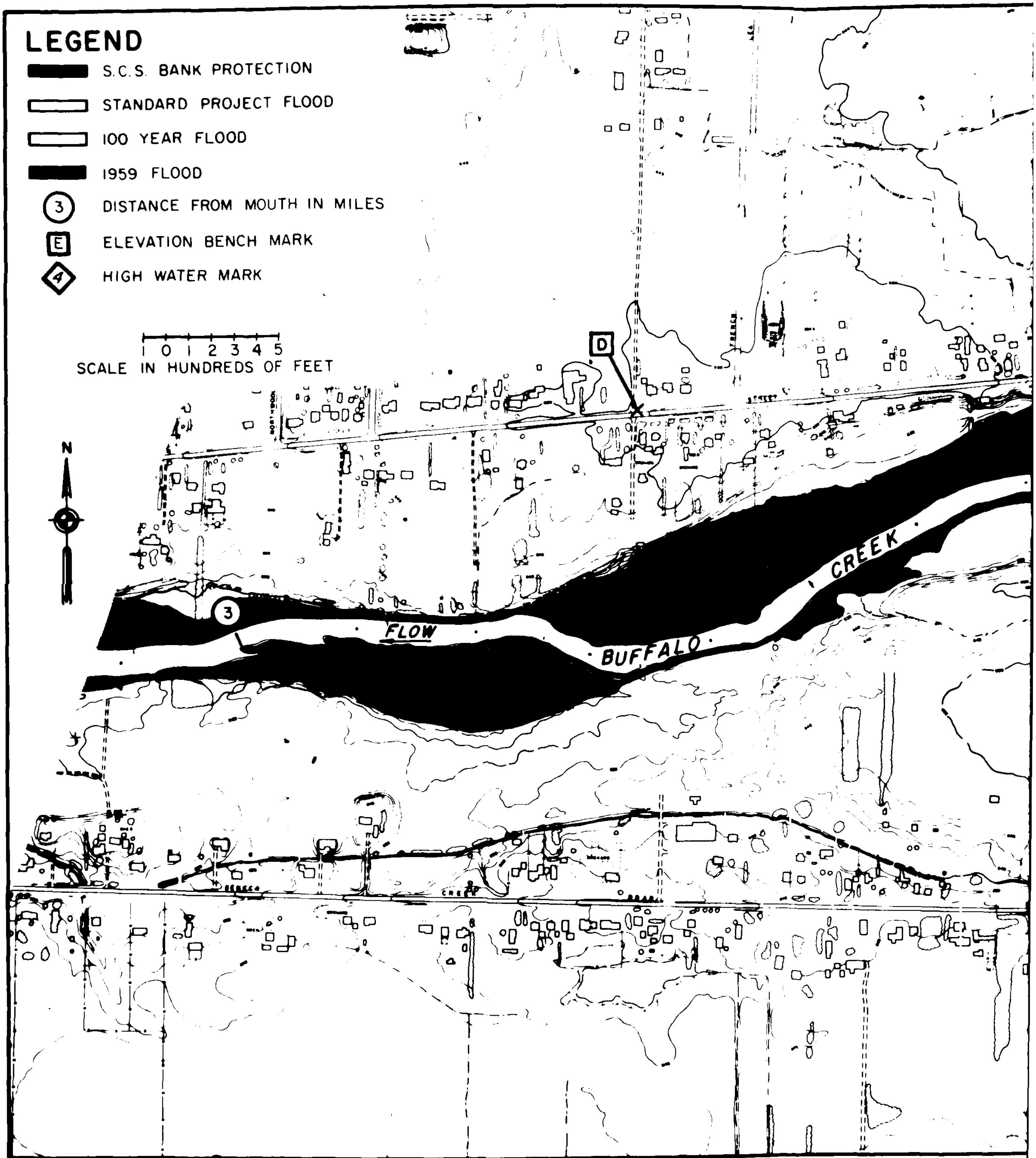

LEGEND
S.C.S. BANK PROTECTION
STANDARD PROJECT FLOOD
100 YEAR FLOOD
1959 FLOOD
DISTANCE FROM MOUTH IN MILES
ELEVATION BENCH MARK
HIGH WATER MARK
EXISTING WATER GAGE
1 0 1 2 3 4 5
SCALE IN HUNDREDS OF FEET
N
GARDENVILLE
BUFFALO CREEK
FLOW
USGS GAGE REFERENCE POINT
CHURCH
FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA
FLOODED AREAS
MILE 0.0 TO 2.9
U.S. ARMY ENGINEER DISTRICT, BUFFALO
3

PLATE 2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S.C.S. BANK PROTECTION
STANDARD PROJECT FLOOD
100 YEAR FLOOD
1959 FLOOD
3 DISTANCE FROM MOUTH IN MILES
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4 HIGH WATER MARK
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SCALE IN HUNDREDS OF FEET
N
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FLOW
BUFFALO CREEK

2


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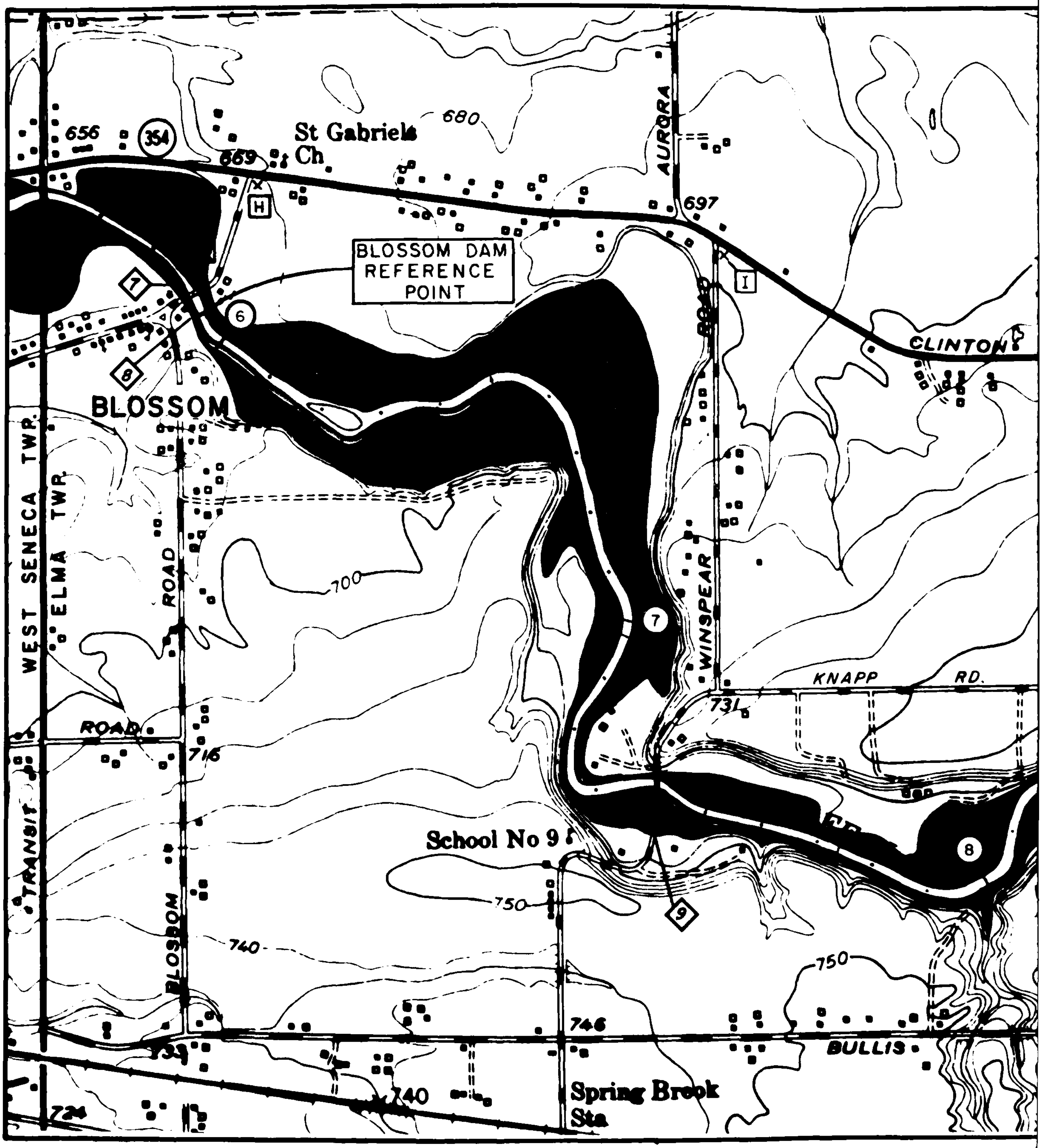
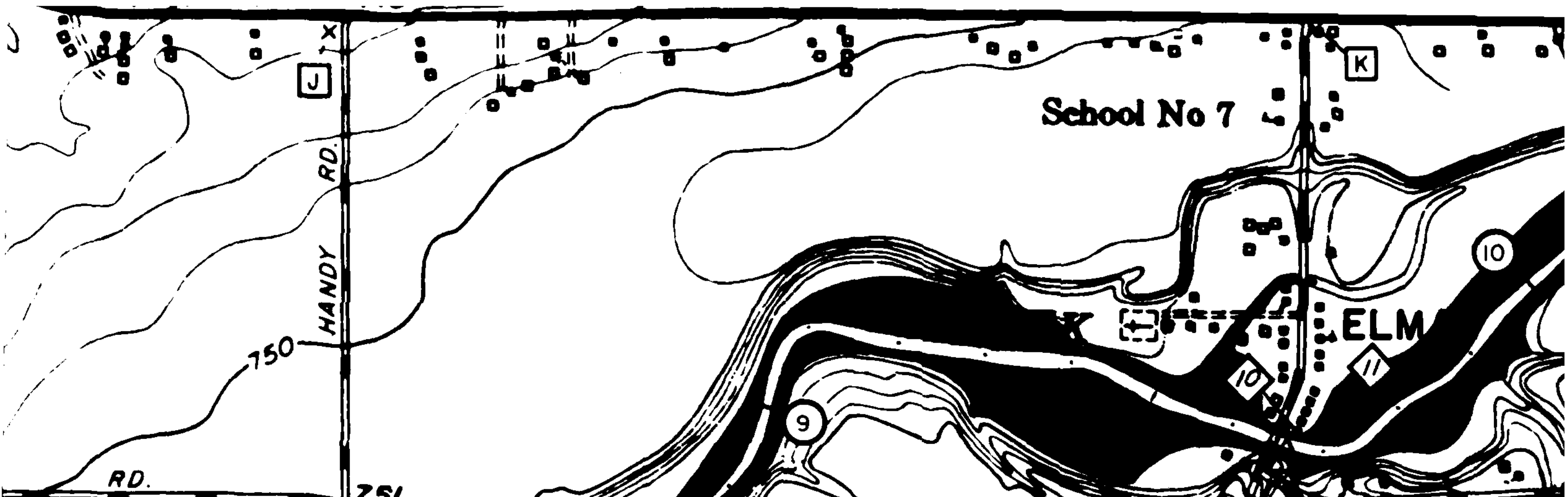
G
5
6
CREEK
FLOW
FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
FROM CAYUGA CR. THRU ELMA TOWNSHIP
FLOODED AREAS
MILE 2.9 TO 5.6
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 3



St Gabriels Ch
680
656
354
669
697
AURORA
BLOSSOM DAM
REFERENCE
POINT
H
I
6
7
8
CLINTON
BLOSSOM
ROAD
WEST SENECA TWR.
ELMA TWR.
ROAD
700
WINSPEAR
KNAPP
RD.
731
ROAD
716
TRANSIT
School No 9
750
9
740
BLOSSOM
750
746
BULLIS
733
740
724
Spring Brook
Sta



J
K
School No 7
HANDY RD.
RD.
750
751
10
ELM
11
9
8
STAFF GAGE
760
750
774
ROAD
770

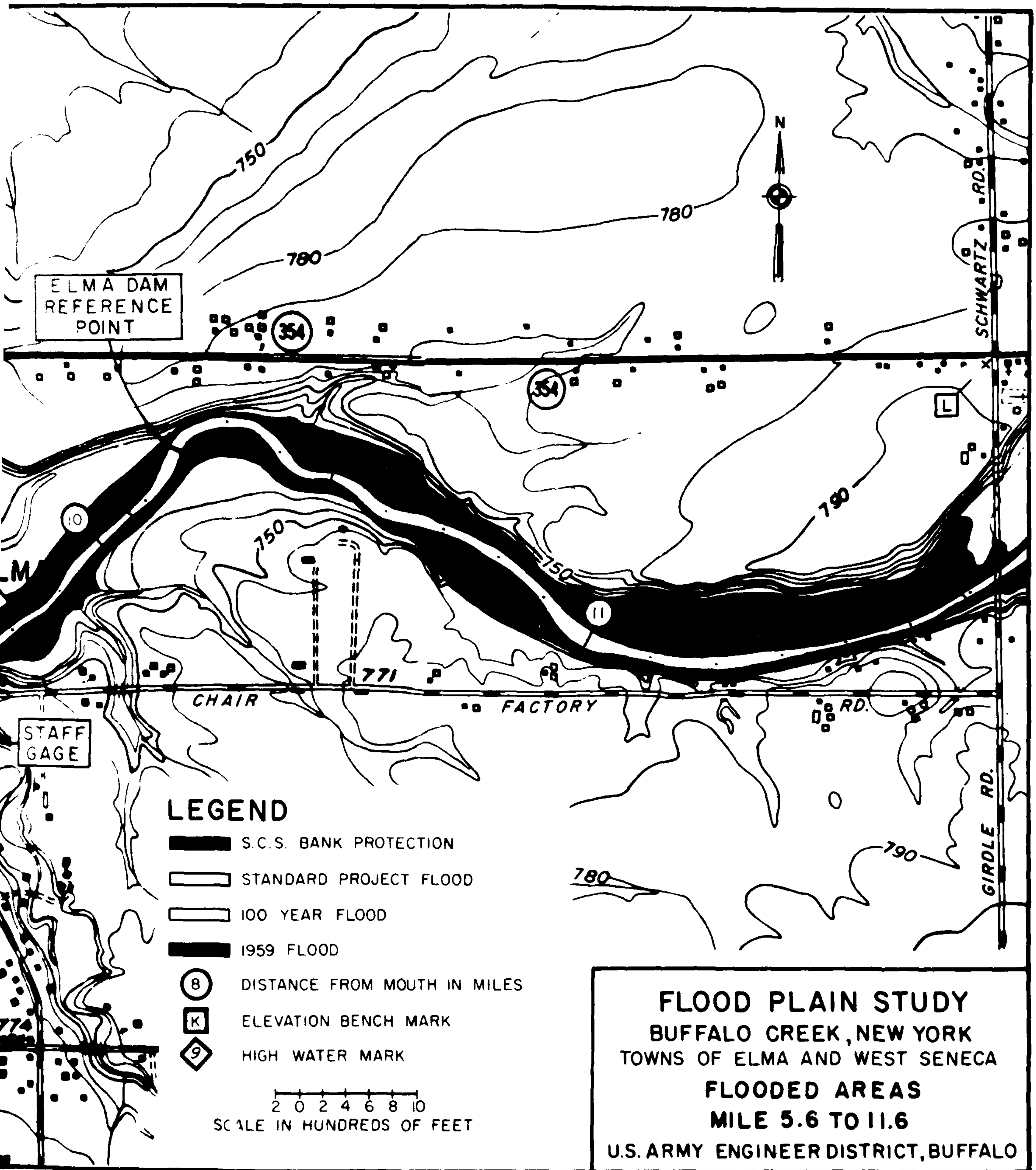
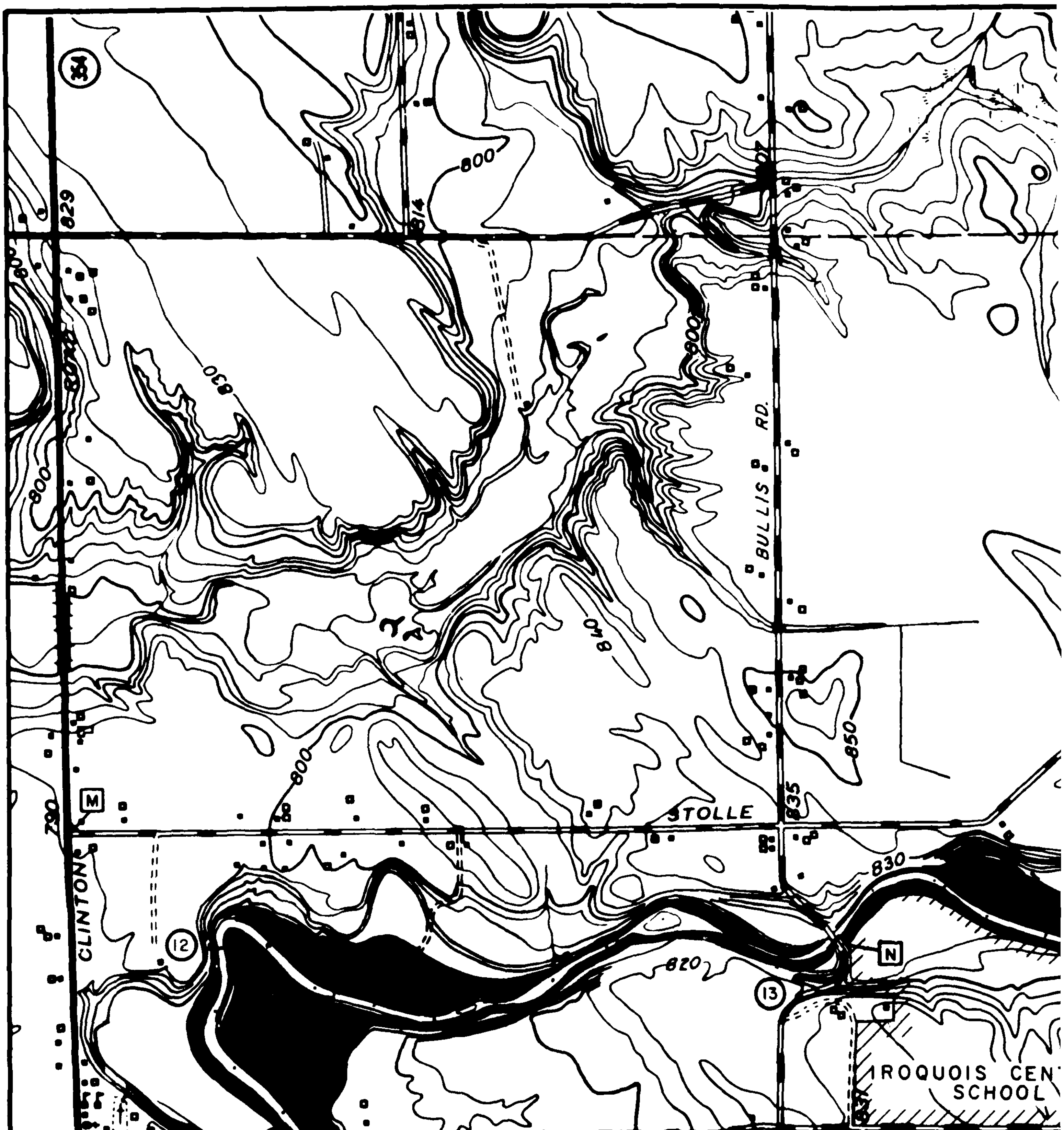

750
780
780
N
ELMA DAM
REFERENCE
POINT
354
354
SCHWARTZ RD.
L
790
10
750
750
11
771
CHAIR
FACTORY
RD.
STAFF
GAGE
GIRDLE RD.
790
780
774
LEGEND
S.C.S. BANK PROTECTION
STANDARD PROJECT FLOOD
100 YEAR FLOOD
1959 FLOOD
8 DISTANCE FROM MOUTH IN MILES
K ELEVATION BENCH MARK
9 HIGH WATER MARK
2 0 2 4 6 8 10
SCALE IN HUNDREDS OF FEET
FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA
FLOODED AREAS
MILE 5.6 TO 11.6
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 4



354
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830
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850
835
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820
BULLIS RD.
STOLLE
CLINTON
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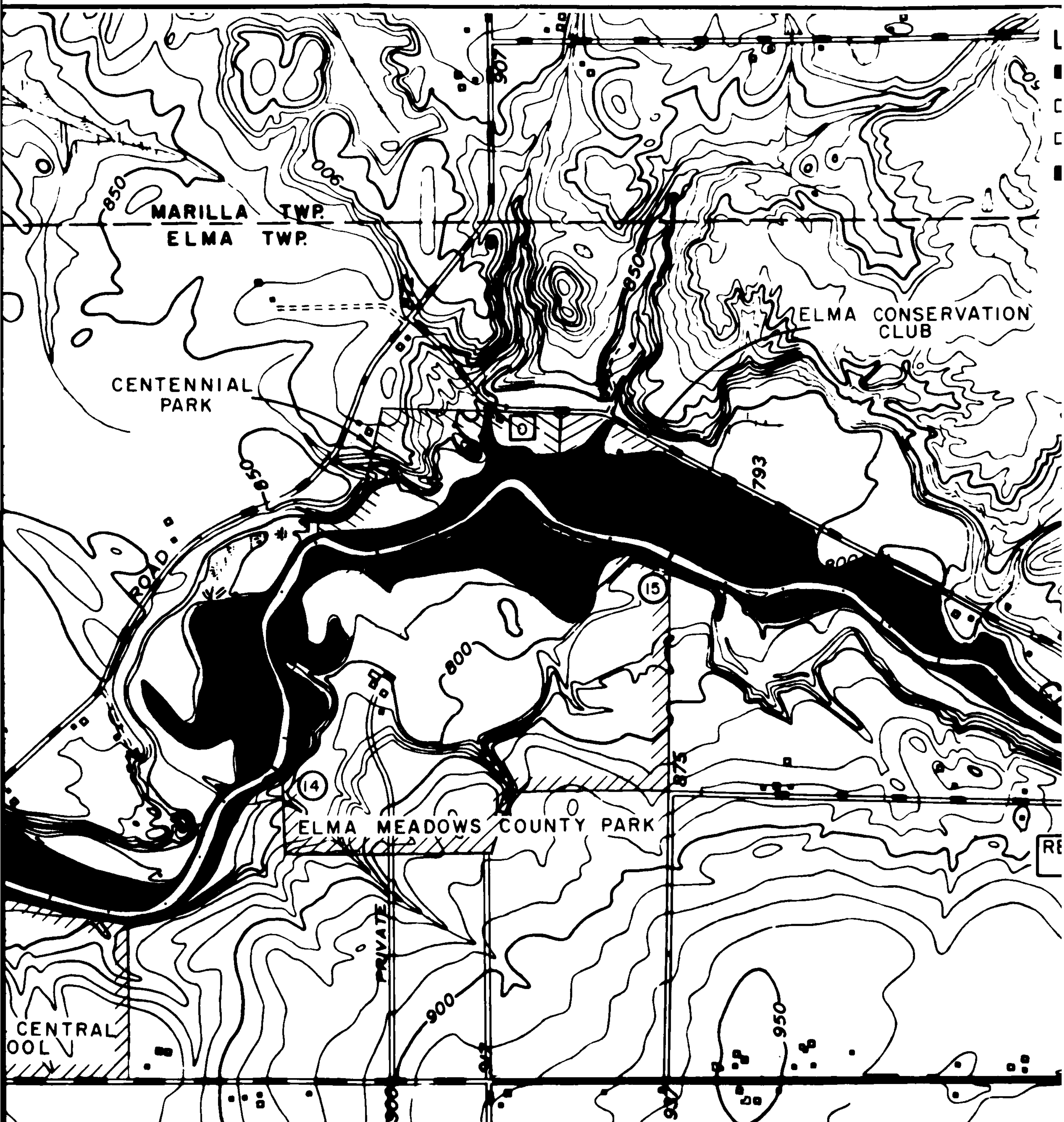
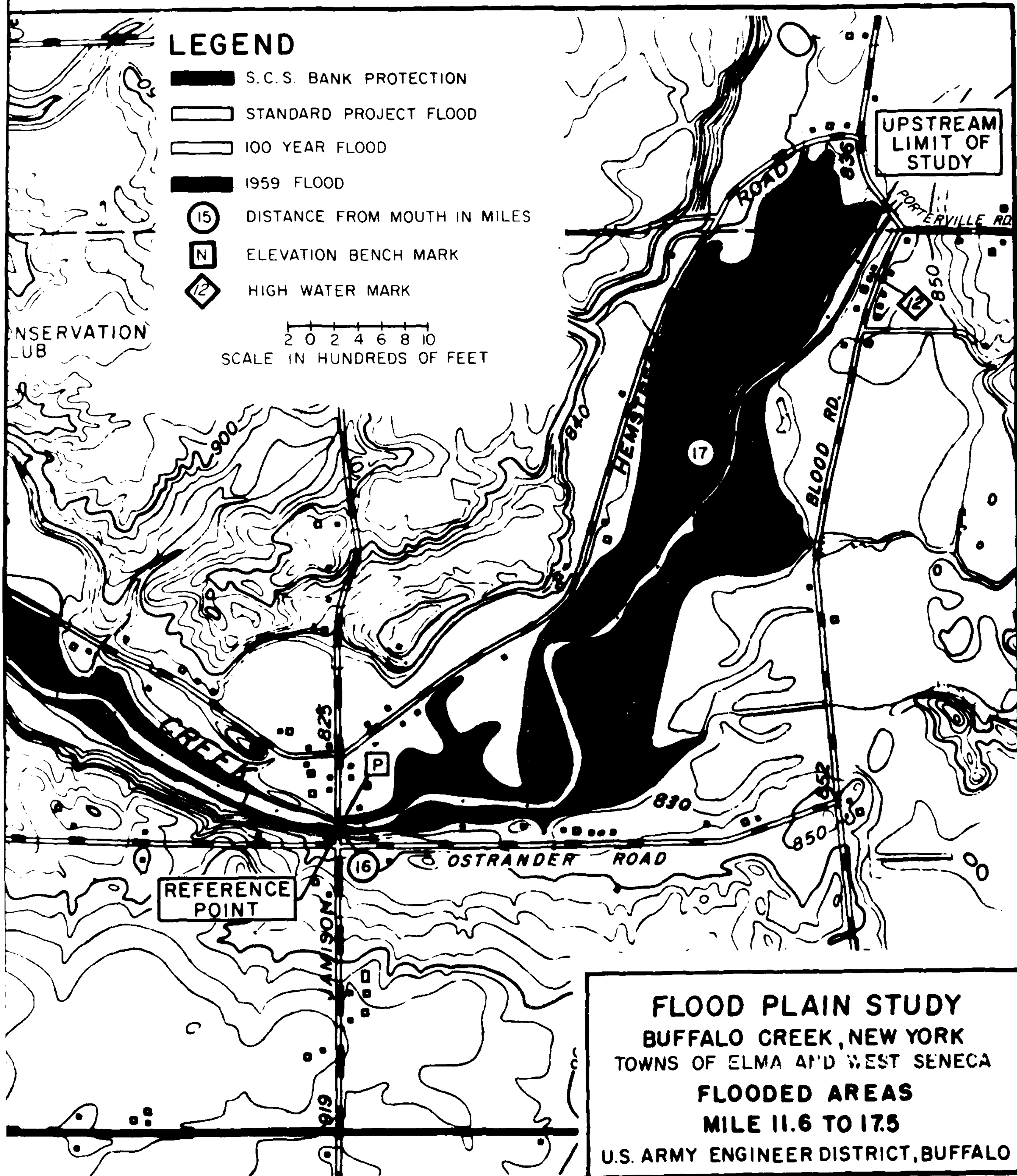
N
12
13
IROQUOIS CEN
SCHOOL

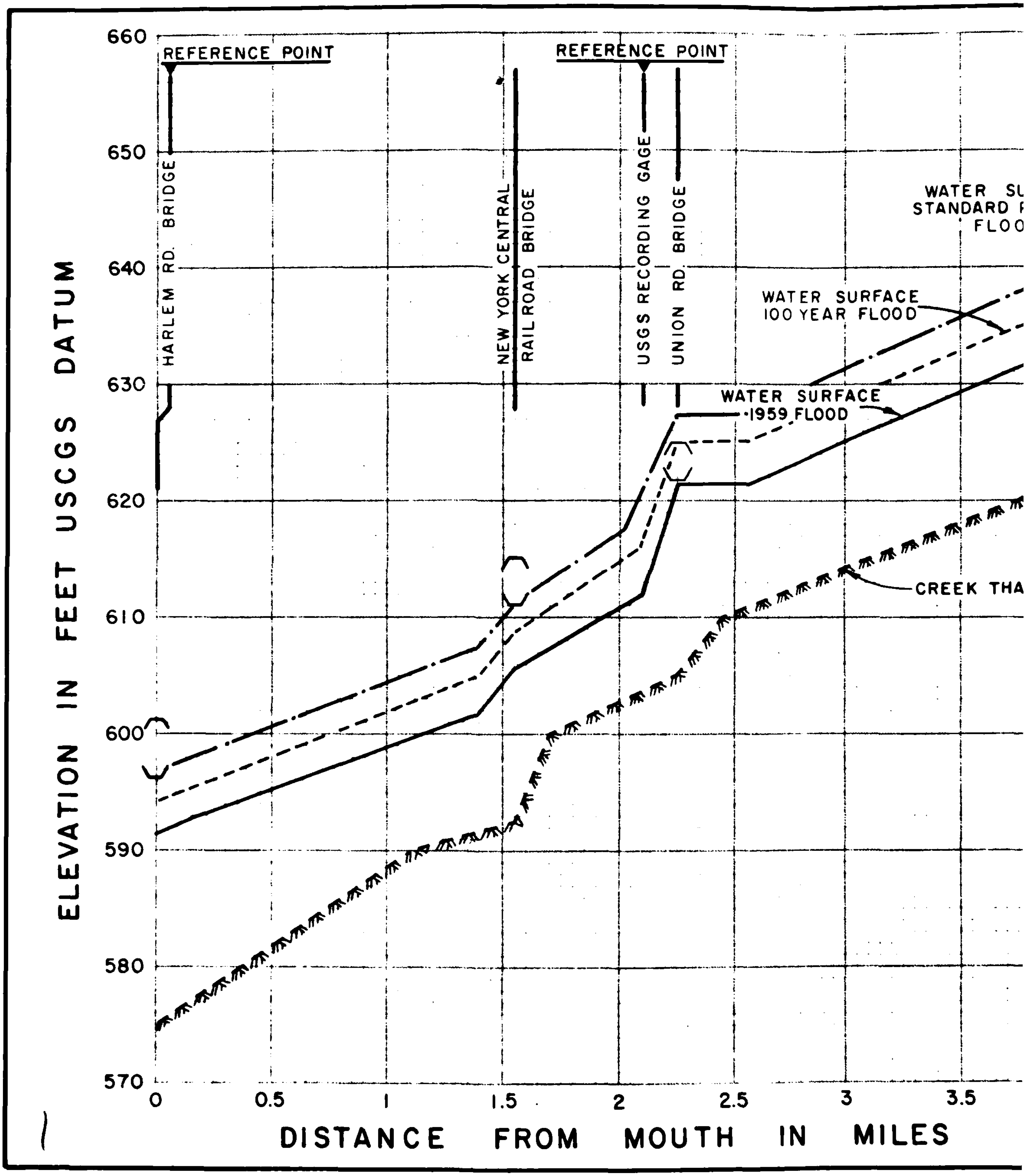

MARILLA TWP.
ELMA TWP.
850
900
CENTENNIAL PARK
ELMA CONSERVATION CLUB
793
800
15
14
ELMA MEADOWS COUNTY PARK
ROAD
PRIVATE
900
950
CENTRAL
OOL
875

2

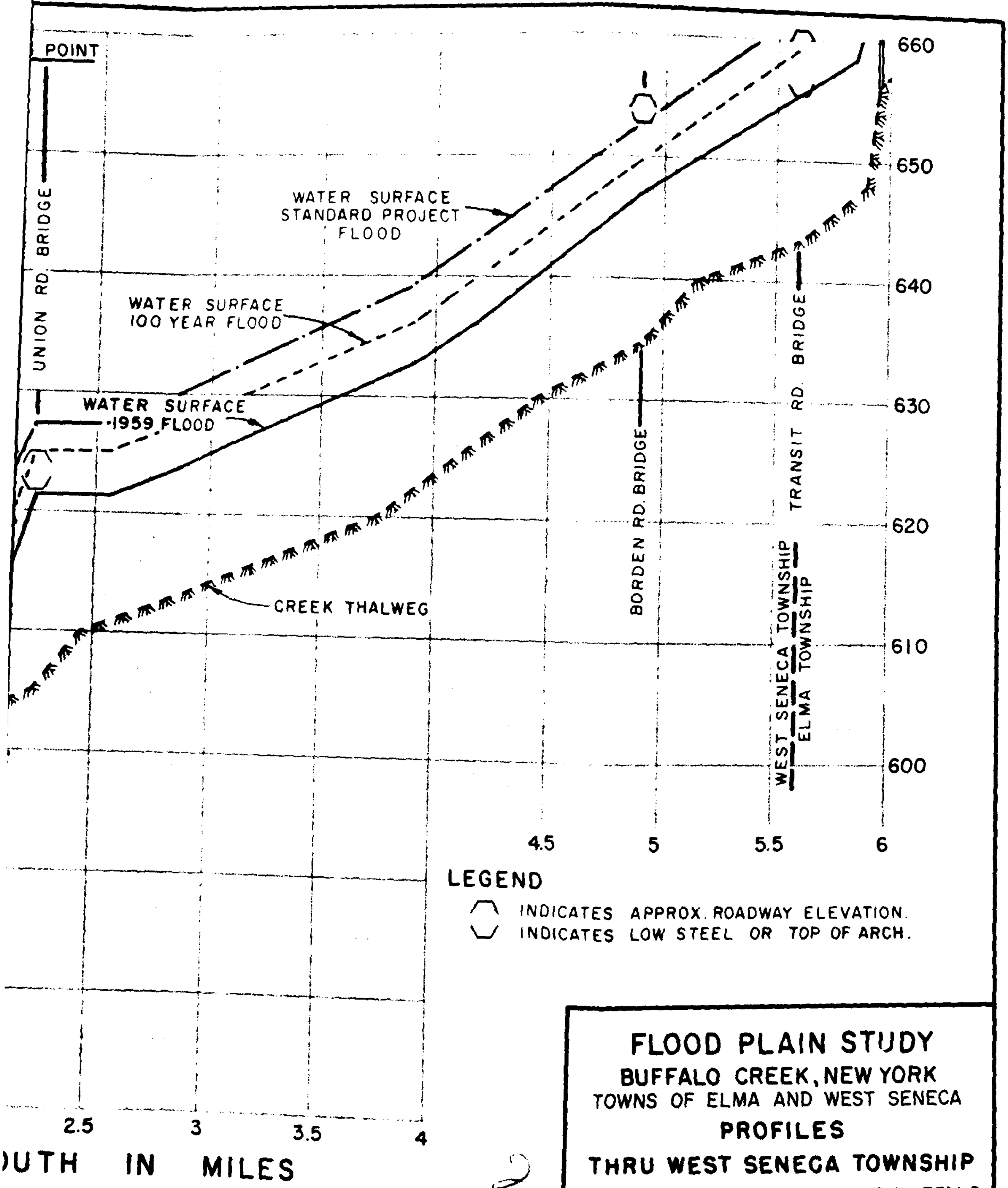


FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA
FLOODED AREAS
MILE 11.6 TO 17.5
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE 5



REFERENCE POINT
REFERENCE POINT
HARLEM RD. BRIDGE
NEW YORK CENTRAL RAIL ROAD BRIDGE
USGS RECORDING GAGE
UNION RD. BRIDGE
WATER SU
STANDARD P
FLOO
WATER SURFACE 100 YEAR FLOOD
WATER SURFACE 1959 FLOOD
CREEK THA
ELEVATION IN FEET USCGS DATUM
660
650
640
630
620
610
600
590
580
570
0
0.5
1
1.5
2
2.5
3
3.5
DISTANCE FROM MOUTH IN MILES



FLOOD PLAIN STUDY

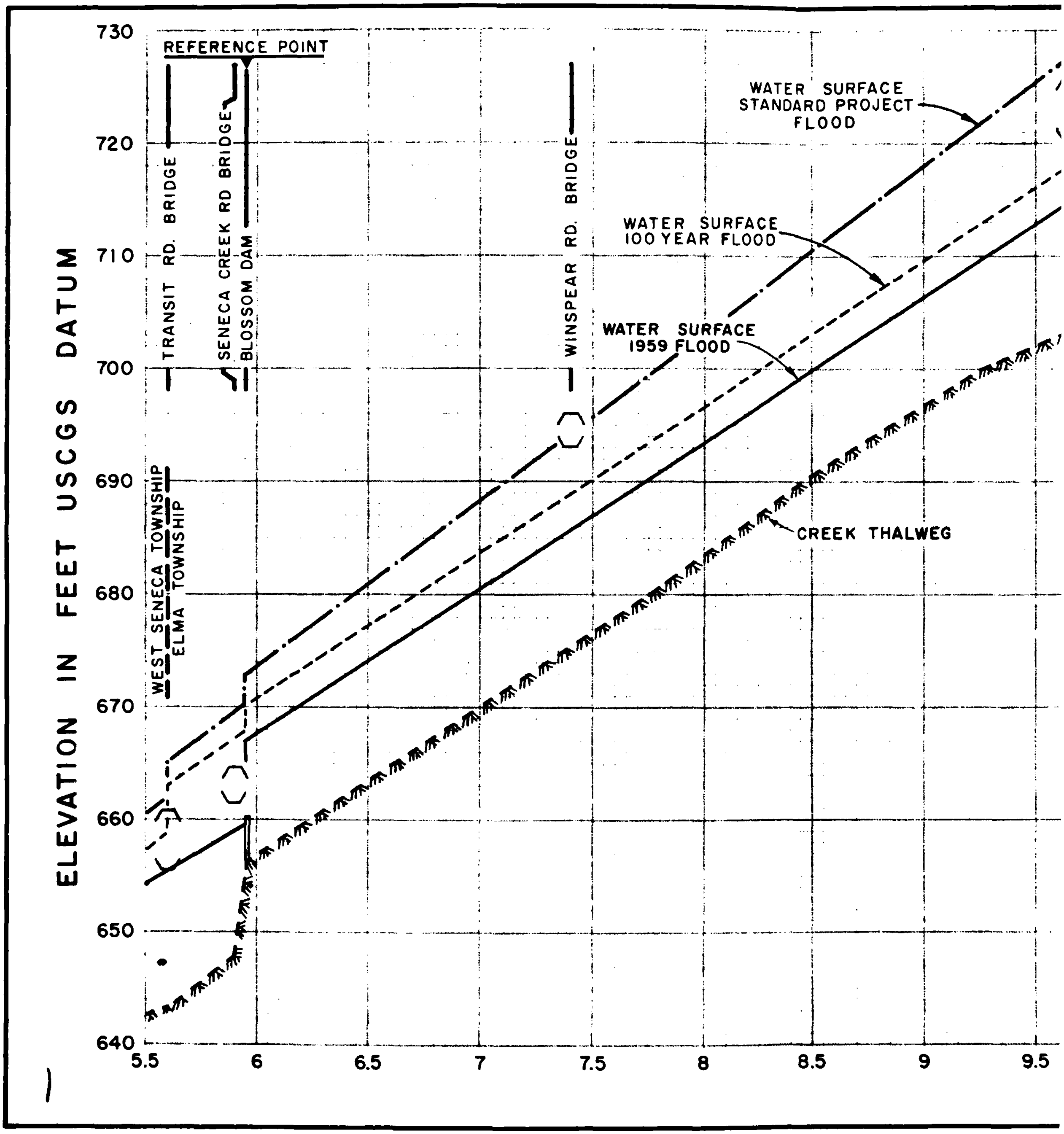
BUFFALO CREEK, NEW YORK

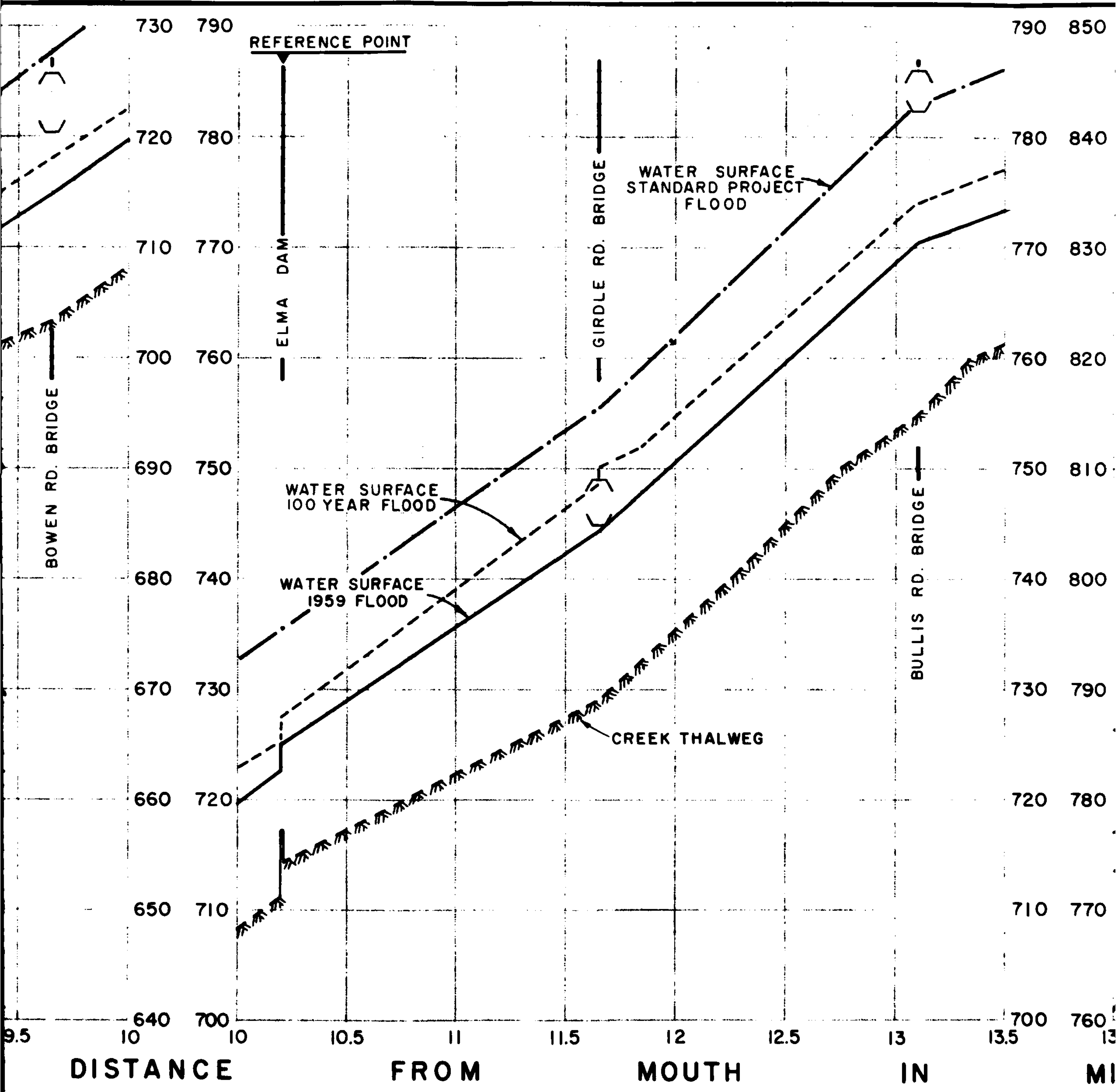
TOWNS OF ELMA AND WEST SENECA

PROFILES

THRU WEST SENECA TOWNSHIP

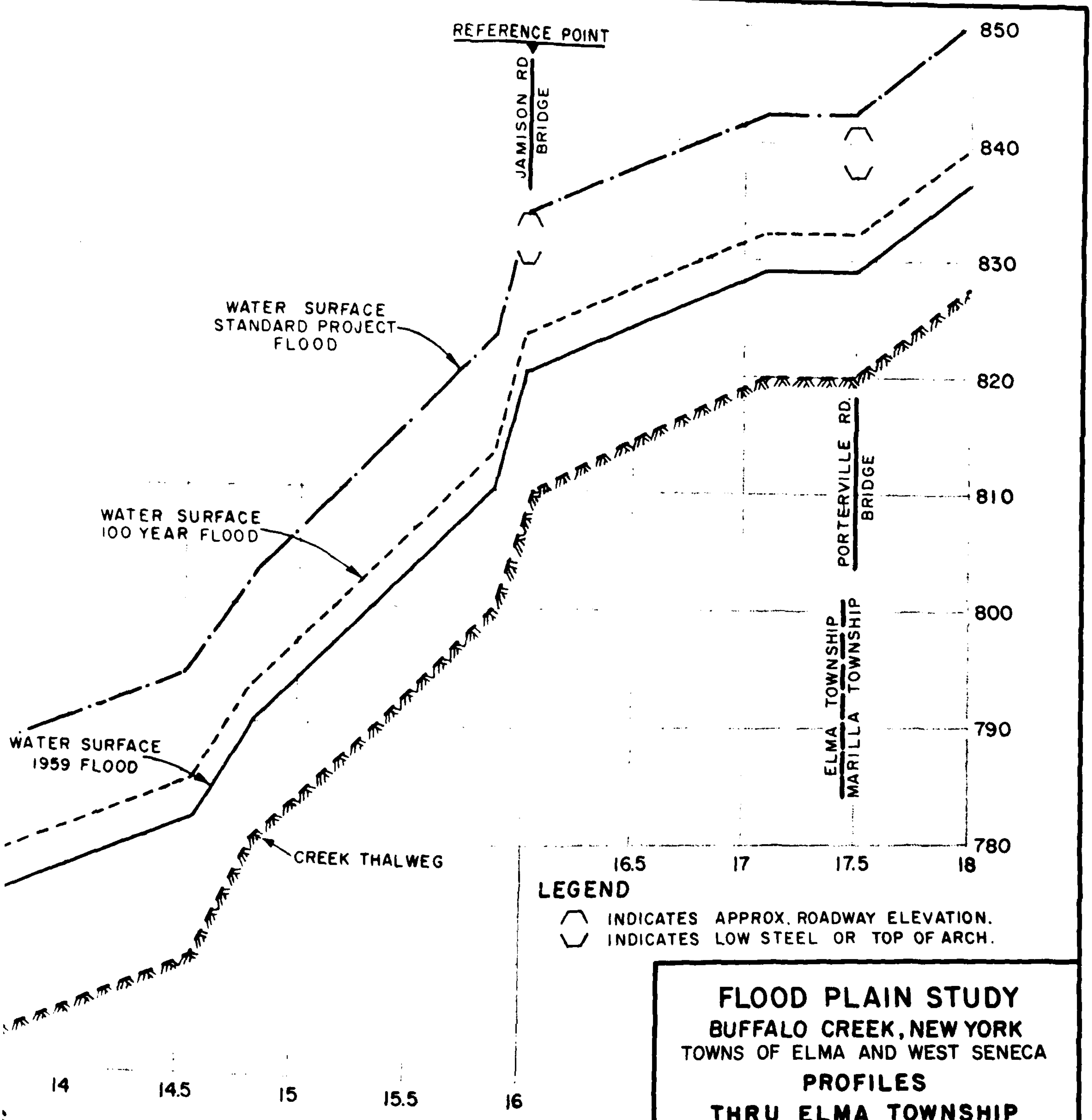
U.S ARMY ENGINEER DISTRICT, BUFFALO


ELEVATION IN FEET USCGS DATUM
730
720
710
700
690
680
670
660
650
640
5.5
6
6.5
7
7.5
8
8.5
9
9.5
REFERENCE POINT
TRANSIT RD. BRIDGE
SENECA CREEK RD BRIDGE
BLOSSOM DAM
WINSPEAR RD. BRIDGE
WEST SENECA TOWNSHIP
ELMA TOWNSHIP
WATER SURFACE
STANDARD PROJECT
FLOOD
WATER SURFACE
100 YEAR FLOOD
WATER SURFACE
1959 FLOOD
CREEK THALWEG



REFERENCE POINT
ELMA DAM
GIRDLE RD. BRIDGE
BOWEN RD. BRIDGE
BULLIS RD. BRIDGE
WATER SURFACE STANDARD PROJECT FLOOD
WATER SURFACE 100 YEAR FLOOD
WATER SURFACE 1959 FLOOD
CREEK THALWEG
730 720 710 700 690 680 670 660 650 640
790 780 770 760 750 740 730 720 710 700
790 780 770 760 750 740 730 720 710 700
850 840 830 820 810 800 790 780 770 760
9.5 10 10 10.5 11 11.5 12 12.5 13 13.5
DISTANCE FROM MOUTH IN MI

2



FLOOD PLAIN STUDY

BUFFALO CREEK, NEW YORK

TOWNS OF ELMA AND WEST SENECA

PROFILES

THRU ELMA TOWNSHIP

US ARMY ENGINEER DISTRICT, BUFFALO

PLATE 7

FLOOD PLAIN INFORMATION

STATE OF NEW YORK

ATTACHMENT

FLOOD PLAIN INFORMATION

STATE OF NEW YORK

ATTACHMENT

GENERAL DISCUSSION OF GUIDE LINES FOR FLOOD PLAIN REGULATIONS AND FLOOD PROOFING PRACTICES

1. GENERAL

Regardless of the location of the flood plain or the overall plan of development for the area, the available methods of controlling future flood plain use and of flood proofing existing structures in the flood plain are generally the same. The information in this attachment contains only general suggestions and the details of the regulatory legislation must be tailored to the plan of development for the flood plain concerned. The profiles and flooded area maps contained in the main report provide the basis for this legislation. Useful advice and assistance may be also obtained from those localities where ordinances based on flood plain information studies have already been adopted.

2. METHODS FOR ESTABLISHING FLOOD PLAIN USE

Several sources of information on the problems and preparation of flood plain regulation legislation are included in the bibliographies on Development of Flood Plain Regulations and Planning References which follow this attachment. Several methods of regulating development in flood plains are contained in these references. Some of the controls for the use of the flood plain are discussed in the following paragraphs:

a. <u>Floodway and Restrictive Zones</u>

(1) In order to maintain the necessary floodway for the selected flood, it is essential that encroachment lines or limits are established. These are two definitely located lines, one on each side of the river. Between these lines, no construction or filling should be permitted which will cause an impedance to flow. Final choice of the magnitude of the selected regulatory flood, which in turn will determine the allowable types of development in the affected areas, is a matter for local decision, since in the final analysis it is determined by consideration of their

land usage needs. Since the size of the regulatory flood will be decided upon by local interests after receipt of this report, it is not practical to suggest encroachment limits at this time. However, the Corps of Engineers will provide technical assistance upon request to compare the effects of various widths of floodway on the profile of the flood which is selected by local authorities as the basis for the regulation of the flood plain.

(2) In addition to establishing floodway limits, it is imperative that adequate criteria be set up to regulate vertical and horizontal clear openings and minimum low steel elevations for bridges crossing the flood plain. Bridge piers in the stream channel should be avoided if possible. If the span length requires that piers be used, they should be streamlined and placed parallel to the flow of water. On many creeks, alinement of the bridge crossing to provide for effective passage of ice is also an important consideration. The most economical means of crossing a stream is the use of earth embankments with a small bridge or culvert. Unfortunately, this type of structure is the least desirable from a flood damage point of view. If it is kept at a low elevation, it is frequently overtopped and then fails to serve its intended purpose. If the roadway and embankment are kept high, the structure will act as a dam and increase flood stages upstream if the waterway opening is not adequate. The waterway opening should not only be sufficient in area but the area must be available at an elevation which will carry flood flows at a level which does not cause damage. It is sometimes necessary to carry the roadway on a series of piers or bents in order to provide sufficient waterway for flood flows.

(3) Channel bottom profiles should also be well defined. Restrictions should be developed for construction in the channel so that future sewers, utility lines or bridge pier foundations will not interfere with flood flows, suffer damage by floods, or cause expensive modifications if channel improvement is undertaken at a later date. Low dams on the stream, which provide little or no storage and are no longer in use, should be removed in order to reduce the water surface in the immediate area. When a dam is allowed to remain in place the shoal area which forms at the upstream end of the pool should be removed periodically and in order that ice floes and debris are not easily grounded. Sewer crossings should be made beneath the bottom of the stream in order to keep the channel free of unnecessary obstructions.

(4) Other factors adversely affecting flood occurrences are extensive earth or refuse fills within the flood plain and sharp bends in the river channel. Moderate filling within the restrictive zone should have little effect on upstream water surface elevations unless it occurs at an already constricted section. Flood plain regulations may permit a limited amount of filling in the restrictive zones in order that proposed structures may be built above the regulatory elevations. On the other hand extensive filling in these areas will result in a reduction of valley storage capacity which may produce higher peak discharges downstream or cause increased stages upstream through the loss in discharge capacity. Floodway limits or encroachment lines should be established to control filling within the flood plain area in order that the filling will not cause a serious increase in water surface elevations during an occurrence of the selected flood. Sharp bends in the river channel are a form of restriction to flow. As such, they tend to raise upstream stages as well as provide potential trouble spots for the occurrence of ice jams. Any man-made modifications to the flood plain, which tend to increase the sharpness of these bends or restrict the channel, should be avoided. It is sometimes possible to modify the bend with a local channel improvement which would reduce water surface elevations and ice jam occurrences in the immediate area.

b. Zoning - Zoning is a legal tool used by cities, villages and towns to control and direct the use and development of land and property within their jurisdiction. A listing of localities which have adopted zoning ordinances which were based on flood plain information studies is given in the bibliography at the end of this attachment. Correspondence with the local governments concerned may provide useful information on the enactment and enforcement of effective ordinances.

(1) Zoning ordinances should be the result of a comprehensive planning program for the entire area with the purpose of guiding its growth. The State of New York enabling statute which permits zoning is contained in Section 263 of the Town Law. If possible, a double zoning technique is often desirable. In preparing a master land use plan, all areas should be zoned for their most appropriate use. This would be the pattern of development that planners and local officials envision for the locality. Then, because of the flood problem, flood zone restrictions for the appropriate area could be superimposed on the regular zoning map and provisions written into the ordinance specifying the kind of improvement necessary to have these restrictions removed: for example, channel improvement or levees to be constructed

by the developer, filling to a specified minimum elevation, prohibition of basement construction, specified flood proofing, etc.

(2) With respect to the high flood risk areas adjacent to the floodway, consideration should be given to retaining land for open use, such as agriculture, parks and athletic fields. Care must be taken that, as parks are developed, structures of higher damage potential are not placed at an elevation where they will be affected by floods. An illustration of flood plain zoning is shown on exhibit 1.

c. Building Codes - Building codes can be utilized alone or in combination with flood plain zoning. Since it is not always practical to prevent the location of all buildings in all areas subject to flooding, building codes can be used to minimize structural and consequential damages resulting from flood velocities and inundation to those buildings which must be built within the flood area. Building codes can also be used to reduce damage from floods greater than the flood selected for flood plain reference. Some of the methods adaptable for inclusion in building codes are:

(1) Prevent flotation of buildings from their foundations by specifying anchorage.

(2) Establish basement elevations or minimum first floor elevations consistent with past flood occurrences or the selected flood.

(3) Prohibit basements in those areas subject to very shallow, infrequent flooding where moderate filling and slab construction would prevent virtually all damage.

(4) Require reinforcement to withstand water pressure or high velocity flow and prohibit the use of materials which deteriorate rapidly in water.

(5) Prohibit equipment that might be hazardous to life if submerged. This includes chemical storage, boilers or electrical equipment.

d. Subdivision Regulations - Subdivision regulations can often serve as a supplement to zoning. Regulations may specify the lot size, elevation of land, degree of freedom from flooding, size of floodways and other points pertinent to the welfare of the community. Areas which may be attractive for subdivision development during dry weather may be subject to inundation during high flows. The flooded area maps in the main report will enable local governments to become aware

of possible trouble areas before subdivision permits are issued.

e. Other Controls - The following approaches to flood plain regulation may be adaptable to special situations or may serve as supplemental measures to an overall regulation program.

(1) Building financing. Very little building is carried on without financing. Government and private financing institutions can control development of the flood plain by denying mortgage guarantees or funds to subdivision or individual builders who wish to build in the flood plain area.

(2) Public purchase. Outright public land purchase of the flood plain is another method of preventing flood plain development. This method is most effective when made part of a recreation or park plan for the area.

(3) Flood insurance. Flood insurance at the present time is practically nonexistent. However, its use in the future with rates accurately indicating flood potential, could serve as a substantial aid in regulating flood plain development.

(4) Warning signs. An inexpensive method which may be used to discourage development is the erection of flood warning signs in the flood plain area or the prominent posting of previous high water levels. These signs carry no enforcement but simply serve to inform prospective buyers that a flood hazard exists. Several signs or stage boards erected on public property at several locations within the town showing the levels of a past flood and the 100-year flood would provide a convenient reference and keep residents aware of the flood possibilities.

3. REDUCTION OF FLOOD LOSSES BY FLOOD PROOFING

Those who are already residing in the flood plain and are subject to flood damage may be particularly interested in the methods of flood proofing the affected structures in order to reduce the possible damage. A recommended reference is "Flood Proofing: An Element in a Flood Damage Reduction Program", by John R. Shaeffer. Some of the possible flood proofing measures are listed below. The first three methods are particularly applicable to residences or businesses which normally suffer only basement flooding. In the underdeveloped areas, some of the methods may be incorporated into building codes, zoning or subdivision regulations in order that structures permitted in the restrictive zones can be better

protected for floods greater than the selected reference flood. Exhibit 2 illustrates some of these flood proofing methods.

a. Seepage Control - This method involves the use of asphalt or quick set hydraulic compounds to seal walls which are subjected to water pressure. This approach is often complemented with sump pits and pumping.

b. Prevention of Sewer Backup - In many areas, not subject to direct overflow, considerable damage occurs from backup of sanitary or combined sewers that are overloaded by high storm water runoff, flooded manholes or high tailwater at the sewer outlets. Various types of automatic and manually operated valves and checks can be installed on house sewers as well as on lateral and trunk sewers to prevent flooding from sewer backup. In the absence of these measures a section of pipe screwed in place over basement drains is a cheap, effective means of coping with this problem. It allows water to rise up in the pipe but prevents overflow up to the limit of the length of pipe. It is recommended that, whenever possible, the storm and sanitary sewers be separate systems to prevent backup through a combined system into residences from overloaded storm sewers.

c. Permanent Closure - In a relatively watertight structure, unnecessary openings may be permanently sealed. If the passage of light is desirable, glass brick or other translucent material having adequate structural strength, should be considered.

d. Protected Openings - Sandbagging of doorways and other necessary openings in structures has been used as a temporary emergency protection for many years. Removable bulkheads or flood gates are often a more efficient means of accomplishing the same purpose. These devices can be bolted against a frame containing a neoprene gasket which provides a watertight seal.

e. Protective Coverings - The rapid development of new types of plastics with various specific properties should be considered in connection with sealing and protecting machines and mechanical equipment from silt and rust damage.

f. Fire Protection - The possibility of fire from electrical short circuiting is a potential hazard during flooding. Power shut-off on a large scale is generally not practical because it usually would affect areas outside the flooded zone. Attention to fuse protection for individual structures could reduce the possibility of fire when power is not disrupted.

g. Elevation - The regulation of the minimum elevation above which future structures must be built has been discussed previously in connection with zoning and subdivision regulations. However, for existing structures in flood risk areas, provisions can be made for raising machinery, furniture or other valuable equipment above flood level. Some property owners have protected household furnishings during past floods by carrying them to higher floors. Heating plants can be permanently suspended from the cellar ceiling. It is possible to raise the first floor of a structure several feet in order to stay above normal flood levels. The basement would still be subject to damage, however, unless it could be protected by other flood proofing methods.

h. Watertight Covers - Storage tanks with contents which are damageable by flood waters should be protected by gaskets and watertight caps. Watertight covers should also be installed on manholes in the flooded areas. This can prevent basement damage from overcharged sewers or pumping stations by the relatively frequent floods although property in the flooded area would still be subject to damage from greater floods.

i. Structural Design - Sometimes specific features can be incorporated into the design or orientation of a new structure so that potential damages are minimized. Concrete pilings have sometimes been beautifully integrated into the architectural design of a structure, while simultaneously raising the structure several feet above the flood plain.

j. Utilities Service - Considerable financial loss can occur when power failures cause disruption of refrigeration or heat. Disruption of gas service has a similar effect. Rerouting of utilities to provide separate service for flood affected areas can only be achieved by the utility companies. However, combining a general knowledge of the flood problem with foresight and good planning may simplify and expedite rerouting procedures when flooding does occur. In specific cases bottled gas has been used to supply heat, and gasoline driven generators have been utilized to supply minimum essential power.

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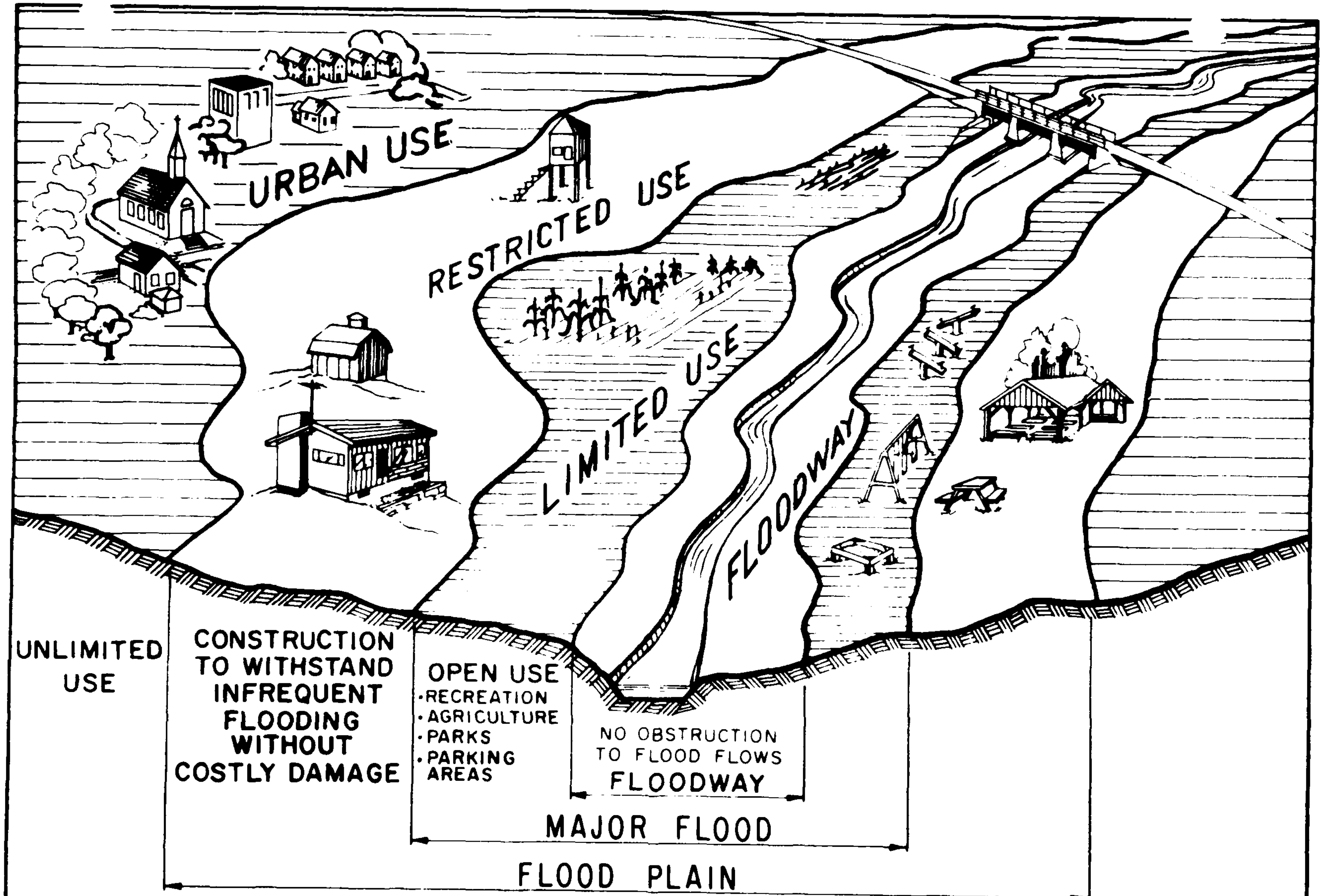
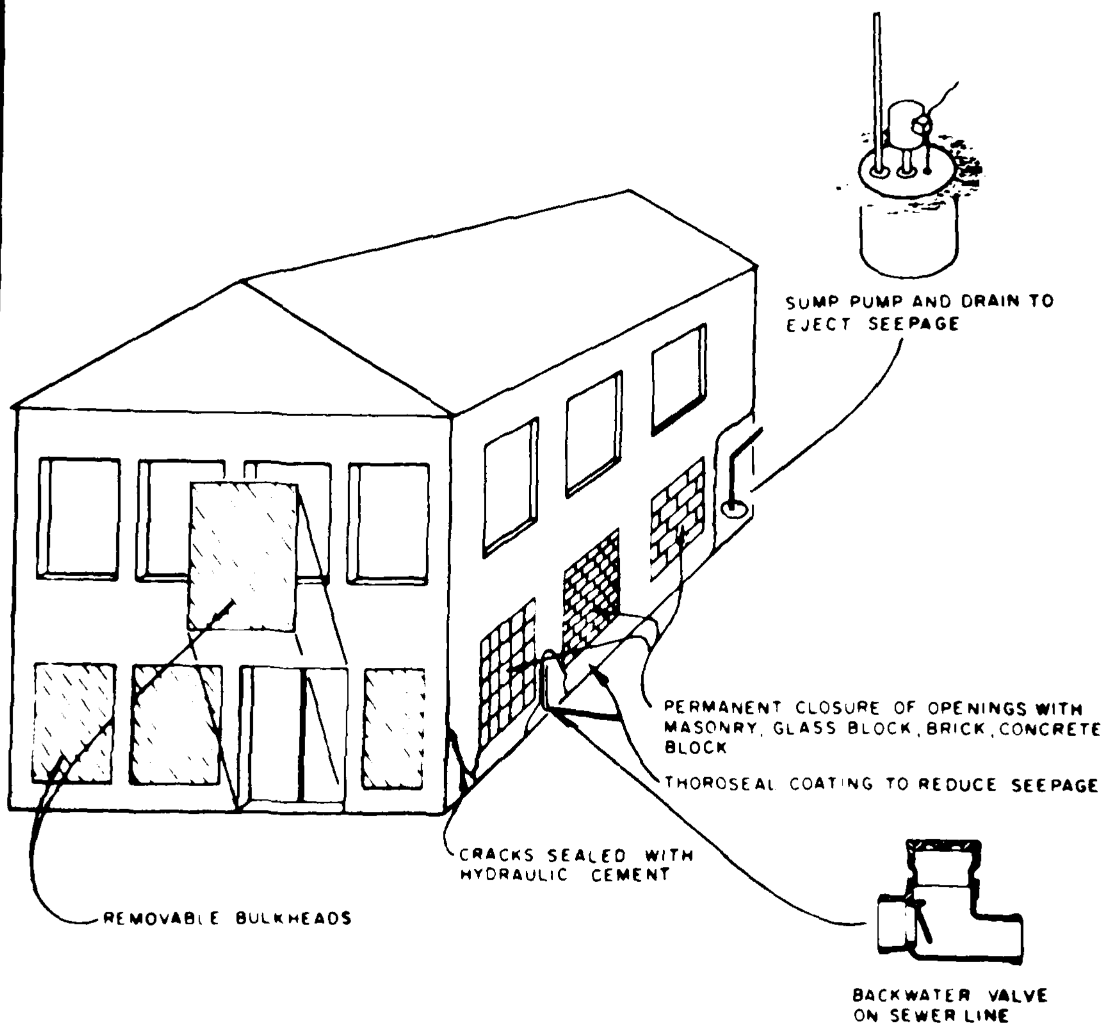


EXAMPLE OF FLOOD PLAIN ZONING

EXHIBIT I



FLOOD-PROOFED STRUCTURE

NOTE:
THIS PLATE REPRODUCED WITH CHANGES FROM "FLOOD PROOFING AN ELEMENT IN A FLOOD REDUCTION PROGRAM," BY JOHN R SHAEFFER.

METHODS OF FLOOD PROOFING A STRUCTURE

EXHIBIT 2

FLOOD PLAIN INFORMATION

BUFFALO CREEK, NEW YORK
in the
TOWNS OF ELMA AND WEST SENECA

TECHNICAL APPENDIX

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PLATES

TECHNICAL APPENDIX

A1. GENERAL

This appendix has been prepared as a supplement to the Buffalo Creek Flood Plain Information Report. Its purpose is to provide additional data for the use of those persons concerned with the technical aspects of flood plain planning. The Buffalo District, Corps of Engineers, can provide an explanation or interpretation of the data included, if necessary, or information on how to obtain additional data that may not be included in this report. Such requests should be first coordinated with the New York State Water Resources Commission, Conservation Department, Albany, New York 12226.

A2. CLIMATOLOGY

There are twelve climatological stations located in or near the Buffalo Creek basin where the U. S. Weather Bureau has collected climatological data. The locations of these stations with respect to Buffalo Creek are shown on plate A1. There are presented in table A1, data on type, location and period of record for these stations. The only first-order Weather Bureau Station is located at the Buffalo Airport.

A3. PRECIPITATION

Annual mean precipitation at each station is shown on plate A1 along with isohyetal lines of equal annual precipitation amounts. The isohyetal pattern shows the area of higher precipitation just east of Lake Erie which includes the Buffalo Creek basin. Average monthly precipitation for all of the stations is compared with average monthly precipitation at Elma and the average monthly runoff at the Gardenville gage on plate A1. During the months of January through April, runoff averages from 50 to 125 percent of the total monthly precipitation, including the water equivalent of snowfall. Annual runoff has averaged about 47 percent of annual precipitation.

A4. SNOWFALL

Average annual snowfall for nearby stations is shown on plate A2 along with lines of equal annual snowfall developed for the adjacent area. Average monthly snowfall for the area stations is shown on the graph on plate A2.

TABLE A1. - Climatological stations in and adjacent to the Buffalo Creek basin

Station	Period of record	Type	Elevation
Arcade	1889-1907 1943-1964	NH	1,480
Batavia	1931-1964	CH	900
Buffalo W. B. Airport	1832-1964	CHJ	705
Derby 2 N. W.	1945-1961	NH	660
Elma	1942-1960	CH	765
Gowanda State Hospital (1)	1945-1964	CHJ	865
Linden	1912-1964	N	1,120
South Wales Emery Park (2)	1931-1964	NH	1,090
Stafford	1931-1964	NH	915
Wales	1948-1964	C	1,150
Warsaw 5 S. W.	1952-1964	N	1,715
Wiscoy	1940-1964	NH	1,200

(1) Known as Gowanda prior to May 1951

(2) Known as South Wales prior to April 1951

C - Recording gage

N - Non-recording gage

H - Snowfall data

J - Supplemental data

The water equivalent of the snow is included in the precipitation figures of plate A1. The snowfall pattern shows an area of higher snowfall running northeast from Lake Erie as moisture laden air is carried from Lake Erie by the prevailing southwest winds.

A5. NOTABLE STORMS

Storms which have produced the most serious flooding in the Buffalo Creek basin occurred on 20-21 June 1937, 1 March 1955, 6-7 March 1956, 20-21 January 1959. Comparative rainfall and runoff data for these storms are shown in table A2. Runoff totaled about 85 percent of precipitation for most storms because of ground conditions or because snowfall on the ground was melted and added to the runoff.

TABLE A2. - Comparative rainfall - runoff data (approximated) for recent notable storms over Buffalo Creek

Storm	Average precip. (in.)	Runoff at Gardenville gage (in.)	Discharge at Gardenville (cfs)	Discharge at Gardenville (cfs/sq. mi.)
17-21 Jun 1937	3.5	2.2	16,000(1)	110.3
Mar 1955	2.1	1.8	13,000	89.6
Mar 1956(2)	1.9	2.0	13,000	89.6
Jan 1959(3)	1.6	1.4	10,000	69.0

(1) Estimated
(2) Some snow melt occurred in upper basin
(3) Approximately 7 inches of snow melted

A6. RAINFALL INTENSITY

The intensity-duration frequency curve on plate A3 indicates how frequently storms of a specific average rainfall intensity lasting for a specific length of time, can be expected to occur over the Buffalo Creek basin. The basic data for plate A3 was derived from U. S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas of the United States". The storm

which produced the March 1955 high water had an average intensity of about 0.31 inches per hour for a period of 7 hours. Plate A3 indicates that storms of this duration and average intensity have a frequency of once in about 5 years. Although data for the June 1937 storm is limited, rainfall at the Buffalo station indicates an intensity of 0.27 inch for 7 hours. A storm of this magnitude can be expected about once every 4 years, however it should be noted that this is data from a single station outside the basin, for a summer thunderstorm, and that the rainfall over the basin most probably was much more intense and severe.

A7. The maximum 24-hour rainfall recorded at Buffalo was 4.28 inches on 28-29 August 1893. On 7 August 1963, the official U. S. Weather Bureau station at the Buffalo Airport recorded 3.88 inches in 24 hours, most of which fell in about 5 hours. A precipitation recorder at the Buffalo Sewer Authority in South Buffalo recorded 4.88 inches for this same period. This storm established new records for one-hour and two-hour durations during the month of August. Plate A3 indicates that the rainfall of 1.75 inches which occurred in one hour has a frequency of once in about 20 years. The 2.58 inches which fell in two hours has a frequency of about once in 50 years, and the 5-hour rainfall of 3.69 inches has a frequency of about once in 100 years. Plate A3 may be especially useful to those designing and approving the design of culverts and other small drainage structures which may be constructed within the basin.

A8. STREAM FLOW RECORDS

The United States Geological Survey has published records of stream flow at the Gardenville gage site since it was established in September 1938. No record was obtained of the estimated maximum flood which occurred in June 1937. A water-stage recorder has been established near Wales Hollow since March 1963. The maximum discharge recorded at this site was 4,430 cfs on 5 March 1964. The equivalent peak discharge at the Gardenville gage was 5,800 cfs on the same day. Discharge per square mile was 55.3 cfs at Wales Hollow and 40.0 cfs at Gardenville for this occurrence. Daily mean discharge and annual peak discharge are published annually by the United States Department of the Interior - Geological Survey in Surface Water Records of New York. Copies of that report may be obtained from District Chief, Water Resources Division, U. S. Geological Survey, P. O. Box 948, Federal Building, Albany, New York 12201. Staff gages have been established by the Erie County Department of Public Works at Harlem Road and Bowen Road. The gages are located on plates 2 and 4, except for Wales Hollow, and are described in table A3.

TABLE A3. - Stage gages

Location	Operating agency	Type	Drainage area sq. mi.	Elevation of gage zero
Harlem Road - downstream abutment, left bank	Erie Co. D.P.W.	Staff (1)	272(2)	5[illegible].4
Gardenville - 700' downstream of Union Road, left bank	U.S.G.S.	Recorder in standard gage house	145.[illegible]	[illegible]3.[illegible]
Bowen Road - upstream abutment, left bank	Erie Co. D.P.W.	Staff (1)	133	[illegible]
Wales Hollow - downstream side of Merlau Road, right bank	U.S.G.S.	Recorder in 24-inch pipe well	[illegible]	[illegible]

(1) No discharge rating curve available.
(2) Includes drainage area of Buffalo [illegible]
(3) Estimated from topographic map

A9. FREQUENCY CURVES

The discharge frequency curve for the Gardenville gage as shown on plate A4 was developed in accordance with "Statistical Methods of Hydrology" by Leo R. Beard. This method uses the annual maximum discharges for the period of record. The statistical approach assumes that the logarithms of peak discharges follow a normal distribution and therefore have a standard deviation from the mean. Since the properties of the normal probability curve have been well defined, it is possible to estimate with some justification, the frequencies of occurrence of future floods of varying magnitudes. The longer the period of record, the more reliable are estimates of the frequency of future floods.

A10. Discharge-drainage area relationships can be developed for basins having more than one gage so that frequency curves can be estimated for locations on the stream other than gage sites. Although there are two gage locations on Buffalo Creek, Wales Hollow has been established for such a short period of time that the discharge-drainage area relationship that [illegible] be developed might not be valid. Cayuga Creek, [illegible] Creek and Buffalo Creek are all [illegible] creeks and Cattaraugus Creek [illegible]

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and are subject to the same storms. A discharge-drainage area relationship was developed using data from the gages at Lancaster on Cayuga Creek, near Ebenezer on Cazenovia Creek, at Gardenville on Buffalo Creek, and at Gowanda on Cattaraugus Creek. The relationship was developed by plotting the mean annual discharge (two-year frequency) for the period of record vs. drainage area on log-log paper and determining the equation for the line of best fit through the points. The resulting equation is $Qm = 196\ A^{.736}$ where "Qm" is the mean annual flood discharge in cfs (50% exceedence) and "A" is area expressed in square miles. This generalized curve is shown on plate A5. Discharge frequency curves were developed for reference points at Harlem Road and East Elma. The mean annual discharge was determined for the drainage area at each reference point from the above equation and the standard deviation (slope on log-probability paper) was determined from the plotting of standard deviations also given on plate A5. The resulting discharge-frequency curves are given on plate A4. The information on plate A5 may be used to develop a discharge frequency curve for any point in the basin where the drainage area is known.

A11. Since creek stages in the flood plain study are often affected by ice jams, it was necessary to develop stage frequency curves so that flood plain regulations could be based on the stage frequency relationship which normally causes damage. A stage frequency curve was developed at the Gardenville gage site using the maximum annual stages whether from discharge or ice jam. These recorded stages were listed in order of magnitude and were then used as basic data to produce a frequency array based on plotting position for the 25 years of record. Each stage was given its corresponding frequency from the table on plate No. 8 of the Beard text. The stage frequency relationship is shown on plate A6 and compared with the stage frequency which results from the discharge frequency and rating curve for the gage. This comparison indicates the effects that ice jams or other transient obstructions can have on the stage frequency relationship.

A12. Stage frequency curves have also been developed for the reference points at Harlem Road, Blossom, Elma and East Elma using the rating curves developed at these locations as described in paragraph A13 and the discharge frequency curves shown on plate A4. These stage frequency curves are shown on plate A6 and represent free flow conditions. The known elevations of ice jam floods have also been plotted on these curves at the same frequency that was indicated for that flood at Gardenville and a curve plotted through the points. Although

this relationship cannot be considered completely valid it does provide an indication of the possible effect of ice jams at these locations. The profile and flooded area for the 100-year flood were estimated from the higher elevation of the 100-year frequency at the reference points as shown on plate A6.

A13. RATING CURVES

The stage discharge relationship for the gage site as shown on plate A7 was developed from the discharge measurements made at the site by the United States Geological Survey. The rating curve is well defined by discharge measurements to 3,200 cfs and was extended through the slope area determination of 7,000 cfs at a stage of 7.07 feet from the 11 March 1952 flood. Rating curves at Harlem Road and East Elma were developed from known cross-sections, discharges and high water levels using Manning's formula for open water conditions. Manning's formula for open channel flow is $Q = \frac{1.486}{n} AR^{2/3}S^{1/2}$ where:

Q = discharge in cubic feet per second

n = a friction constant which is an index of the relative resistance to flow of the surface over which the water is flowing

A = cross sectional area of the waterway in square feet to the water surface

R = hydraulic radius - the ratio of the cross sectional area of the waterway at the water surface to the perimeter of the channel or overbank which comes in contact with the water

S = slope of the water surface in foot per foot

Known flood levels and discharges were used in establishing channel "n" factors and water surface slopes. These factors and slopes were then used with varying elevations and areas to determine other discharge points. The computed rating curves are shown on plate A7.

A14. Rating curves at Blossom and Elma were developed at the dams at these locations using the general equation $Q = CLH^{3/2}$ where:

Q = discharge in cubic feet per second

C = discharge coefficient depending on shape and submergence of dam

L = length of spillway

H = energy head above crest or in the case of a submerged crest, above the tailwater

The two dams were considered to act as sharp-crested weirs with discharge coefficients of 3.3 until affected by submergence. The discharge coefficient was reduced for the effect of submergence in accordance with EM 1110-2-1603 Hydraulic Design of Spillways 31 March 1965.

These rating curves are valid for open channel conditions only and do not reflect the effect of ice jams or other obstructions. The rating curves have not been extended far enough to show the estimated elevation for the Standard Project Flood. The profile and flooded area for the Standard Project Flood were estimated by using valley sections near the reference points and using the 100-year profile as a guide.

A15. BRIDGES

Data on bridges crossing Buffalo Creek within the study area are given in table A4. Although the high water profiles on plates 6 and 7 indicate that high water nearly fills the bridge opening at Union Road and Transit Road, neither of the bridges unduly raises upstream water surfaces. These bridges along with Borden Road and Winspear Road have relatively low approaches, which are overtopped during the higher flood flows so that the bridges do not act as the control. At Transit Road high water also backs over Clinton Street which parallels the creek at that point. Although having the highways overtopped during floods reduces their effectiveness, raising the approaches would result in higher upstream stages. Any new or replacement bridges across Buffalo Creek, where the roadway is intended to be above flood level, would require a waterway area at least as large as the Seneca Creek Road Bridge. This area should be available below the January 1959 flood elevation at that location.

TABLE A4. - Bridge data

Name of bridge	Approx. river mile	Description	Avg. clear height (feet)	Total clear width(1) (feet)	Skew angle degrees(2)	Low steel elevation (feet)	Approx. roadway elevation (feet)	Approx. waterway area(3) (sq.ft.)
Harlem Road	0.0	5 Span steel beam	20	254	20	596.1[illegible]	601.17	3,013
New York Central RR	1.5	2 Span plate girder	11	158	0	610.96	615.11	1,560
Union Road	2.3	2 Span concrete arch	17	109	0	621.73(4)	625.00(5)	1,405
Borden Road	4.9	2 Span concrete arch	13	120	15	652.46(4)	655.05(5)	1,266
Transit Road	5.6	3 Span steel beam	11	154	0	655.39	660.89(5)	1,445
Seneca Creek Road	5.9	Single span steel truss	13	144	5	661.51	664.59	1,778
Winspear Road	7.4	2 Span concrete arch	13	122	45	693.34(4)	696.00(5)	1,423
Bowen Road	9.6	Single span steel beam	11	116	0	720.25	725.70	1,243
Girdle Road	11.6	3 Span steel beam	15	93	25	744.38	749.00	2,578
Bullis Road	13.1	2 Span concrete arch	15	107	0	782.47	786.1	1,613
Jamison Road	16.0	3 Span steel beam	11	128	10	829.07	833.2	1,124
Porterville Road	17.5	2 Span concrete arch	6	141	15	837.03(4)	841.3	750

(1) Clear width does not include width of piers.
(2) The angle of the skew is measured between the longitudinal axis of the bridge and a perpendicular to the centerline of the channel.
(3) Area below elevation of January 1959 flood. This area must be multiplied by the cosine of the skew angle to obtain the effective area of the bridge, parallel to the flow of water.
(4) Low concrete.
(5) High water floods one or both of bridge approaches.

A16. BENCH MARKS

In determining the elevations of the high water marks through the study area, numerous bench marks were established for vertical control. Table A5 is a listing of the location and description of these bench marks. The bench marks are located, approximately, on plates 2, 3, 4, and 5. The list is furnished as an aid to local interests in establishing staff or crest gages, setting minimum elevations for future development or establishing other elevations necessary to flood plain planning. All elevations for future development in the flood plain area should be comparable with elevations used in this report. All elevations in this report are referred to U. S. Coast and Geodetic Survey datum. The conversion factors between U.S.C. & G.S. datum and other datum planes used in the area are given in table A6. The bench marks listed in table A5 should be suitably marked and preserved.

A17. HIGH WATER MARKS

A tabulation of the high water marks obtained in the study area for the March 1955, January 1959, and March 1962 floods is given in table A7. The approximate locations of the high water marks are shown on plates 2, 3, 4, and 5. These points were used to develop the flood profiles shown on plates 6 and 7. It will be noted that the profiles, as drawn, do not pass exactly through all of the high water marks. All high water marks contain some inaccuracies in reporting due to wave action, velocity head, lack of a suitable reference, etc. The profile must be fitted through the available points considering river slope, channel size and overbank flow areas. The profiles furnished provide sufficient data for use as references for flood plain regulations. The individual high water marks are furnished to provide a series of known elevations from which future flood elevations can be measured. The new flood elevations can be determined by simply measuring up or down from the known high water mark. The elevations from the high water marks can also be transferred to any nearby property to determine the extent and depth of inundation for a recurrence of that flood. The elevations of the high water marks are given to the nearest hundredth of a foot. This amount of precision is not obtained from the original high water descriptions but is the actual elevation of the shiner, paint mark, etc., which marks its location. These marks should be preserved and used as additional bench marks in subsequent flood plain survey work.

TABLE A5. - Bench mark descriptions

Bench mark designation & approximate river mile	Elevation, feet on U.S.C. & G.S. datum	Description
A 0.0	601.73	Harlem Road Bridge over Buffalo River. Approx. 500' south of Harlem Rd. and Clinton St. A chiseled square on the east end of the south abutment.
B 1.5	609.47	New York Central R.R. Bridge over Buffalo Creek. A chiseled square at center of east end of south abutment. Approx. 0.5 feet from steel girder.
C 2.3	628.21	Union Road Bridge over Buffalo Creek. A chiseled square on top of small pillar, second from the south, of the upstream concrete railing wall.
D 3.3	649.67	North side of Clinton and Lindner Dr. A chiseled cross on northeast corner of culvert headwall.
E 4.2	658.88	At Buffalo Air Park, 4500 Clinton St. A chiseled cross on east bolt in top of fire hydrant.
F 4.9	668.61	At northeast corner of Clinton St. and Borden Road. A chiseled cross in the southwest corner of "Esso" sign base, 1.1 feet above blacktop.
G 5.6	661.11	Transit Road bridge over Buffalo Creek. Approx. 200 feet south of Transit Rd. and Clinton St. on the upstream railing support. A chiseled cross on northeast corner of the fourth support from north end of bridge.
H 5.9	668.82	At southeast corner of Clinton and Seneca Creek Road. A chiseled square on the southeast corner of culvert headwall.
I 6.6	697.14	At southeast corner of Clinton and Winspear Road. A chiseled square on the southeast corner of culvert headwall.

TABLE A5. - Bench mark descriptions (Contd)

Bench mark designation & approximate river mile	Elevation, feet on U.S.C. & G.S. datum	Description
J 8.3	718.95	At southwest corner of Clinton St. and Handy Rd. A chiseled cross on the northeast corner of culvert headwall.
K 9.7	765.94	At southeast corner of Clinton St. and Bowen Rd. A chiseled cross on southwest corner of drainage grate frame.
L 11.6	784.64	At southwest corner of Clinton St. and Girdle Rd. A chiseled cross near center of culvert headwall.
M 12.0	790.93	At southeast corner of Clinton St. and Stolle Rd. A chiseled square on the northwest corner of culvert headwall.
N 13.1	788.73	Bullis Road bridge over Buffalo Creek. A yellow paint mark on top of downstream railing wall. Located at center line.
O 14.7	799.05	Approx. 0.2 mile south along Creek Rd. from Stolle Rd. A chiseled cross in the center of east headwall of old culvert bridge, approx. 50' west of present road.
P 16.0	836.08	Jamison Road bridge over Buffalo Creek. Approx. 400' west of Creek Rd. Upstream railing. A chiseled cross on south bolt of the tenth, from the east, railing support.
Q 17.5	844.02	Porterville-East Aurora Rd. bridge over Buffalo Creek. A chiseled square in the top of the upstream railing wall.

TABLE A6. - Conversion factors between United States Coast and Geodetic Survey (U.S.C. & G.S.) and other area elevation data at Buffalo, N. Y.

To obtain U. S. Coast and Geodetic Survey Datum	
Datum	Conversion factor
International Great Lakes datum (1955)	+1.29
U. S. Lake Survey (1935)	-0.56
U. S. Geological Survey	-0.56

NOTE: Although these conversion factors may vary slightly in different localities, they should give satisfactory results for flood plain regulation purposes.

TABLE A7. - Highwater mark elevations

No.	Creek mile	Location	Flood	Description	Reliability	U.S.C. & G.S. elevation
1	0.15	452 Collins Avenue Huppertz Grove West Seneca	Jan 1957	Metal shiner 6.4' above the ground, near the kitchen door on the S.E. Corner - board of the 24' x 45' frame building.	Very good	594.08
			Jan 1959	1.28' below Jan 1957 mark.	Very good	592.80
2	1.95	1300 Indian Church Road West Seneca	Jun 1937	Water came up to approx. 200 feet downstream of an existing manhole at the south end of a row of evergreen trees. About 60' north of the right bank of the Old Mill Race and 150' south of the Buffalo Creek left bank. The elevation of the M.H. Rim is 615.3, water was 3 feet lower 200 ft. downstream of manhole.	Good	612.3
3	2.15	44 School Street West Seneca	Jan 1959	Set metal shiner on left hand side of door jamb 2.2' above the concrete floor on the 2nd bay from the downstream end of the 4-car masonry garage	Good	617.11
4	3.9	4283 Clinton Street West Seneca	Possible 1955 or 1956	Water came up to the yellow paint mark on the third concrete step from the top step. Steps lead down to the creek.	Good	632.84

TABLE A7. - Highwater mark elevations (Contd)

No.	Creek mile	Location	Flood	Description	Reliability	U.S.C. & G.S. elevation
5	4.9	131 Borden Road West Seneca	Mar 1955	Set metal shiner on top of wooden retaining wall on the creek side of the house, 10' east of the cellar drain that extends thru the wall.	Good	646.93
6	5.55	Transit Road Bridge West Seneca	Jan 1959	Horizontal yellow paint mark on the downstream right bank wing-wall 6.14' below top of concrete abutment.	Good	654.85
7	5.85	431 Main Street Elma	Jan 1959	Set metal shiner 1.5' above the bottom of the corner-board on the upstream side of the frame chicken house.	Good	658.40
8	5.95	Blossom Dam Elma	1955 or 1956	Water surface was over the left bank, concrete dam abutment about 9". Elevation of square yellow paint mark on abutment is 666.25.	Good	667.00
9	7.4	Winspear Road Bridge Elma	Mar 1955	Water was 13.0' below yellow paint mark on top of conc. railing post, 1st. one north of ℄ of bridge upstream side.	Average	688.76
10	9.65	Old Fire House Elma	Mar 1962	Water was 2.67' above the concrete basement floor. Set metal shiner on door jamb at the rear of the building on the left side of the double basement doors.	Good	715.85

TABLE A7. - Highwater mark elevations (Contd)

No.	Creek mile	Location	Flood	Description	Reliability	U.S.C. & G.S. elevation
11	9.75	Elma Fire Co., Inc. New Fire House Elma	Mar 1962	Yellow paint mark 8" above the concrete floor, between the 3rd and 4th courses of brick, on the mortar joint near the north door jamb of the north overhead door on the fire hall.	Good	717.55
12	17.45	Mr. O. H. Brooks West Blood Road Elma	About 1921	Square yellow paint mark on top of the upstream driveway curb 1.5' from the garage.	Good	833.56

A18. USE OF THE DATA

The data on climatology and notable storms provide general information on the causes and results of past floods. The rating curves and frequency data give an indication of the return interval of various flood occurrences and thereby provide a basis for selection of the selected regulatory flood. The flood profiles and maps of inundated areas can be used to establish flood plain regulations throughout the study area along Buffalo Creek. The high water mark elevations and bench marks can be used to determine possible flood elevations at any property or prospective development within the study area.

A19. AUTHORIZATION

This flood plain information report has been prepared under the authority granted in Section 206, Public Law 86-645, as amended (Flood Control Act of 1960). The text of Section 206 states, "(a) That, in recognition of the increasing use and development of the flood plains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by States and municipalities, the Secretary of the Army, through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard; provided that the necessary surveys and studies will be made and such information and advice will be provided for specific localities only upon the request of the State or a responsible local governmental agency and upon approval by the Chief of Engineers; (b) The Secretary of the Army is hereby authorized to allot, from any appropriations, hereaftermade for flood control, sums not to exceed $2,500,000 in any one fiscal year for completion and dissemination of such information."

ERIE
COUNTY

DEPARTMENT OF PUBLIC WORKS

H. DALE BOSSERT, P. E. — COMMISSIONER

DIVISION OF DRAINAGE AND SANITATION

CHARLES C. SPENCER, P. E. — DEPUTY COMMISSIONER

ROOM 711, 45 CHURCH STREET BUILDING, BUFFALO 2, N. Y.

TELEPHONE TL 6-7190, EXTENSIONS 289 AND 290

November 17, 1961

Col. Leon J. Hamerly, District Engineer
U. S. Army Corps of Engineers
Foot of Bridge Street
Buffalo 7, New York

Dear Colonel Hamerly:

We have had several discussions with representatives of your office concerning flood plain information studies which your office is authorized to make under Section 206 of Public Law 86-645. We feel that certain studies your office is authorized to make under this law would be very helpful to Erie County. We have secured a copy of Bulletin EM 1165-2-111 dated the 31st of March 1961 stating that local agencies may make an application to the District Engineer for flood plain studies and that they should provide certain information. At the suggestion of Mr. McKee in your office we are sending this application through New York State. We were informed today by the Water Resources Board that Mr. Horace Evans of the State Department of Public Works is handling applications of this nature.

The Erie County Drainage Agency was established by the Board of Supervisors under Item 33, Meeting No. 4 of that body on December 27, 1960. It provided that the Drainage Agency should have the powers prescribed in Article 5-D of the County Law and such other powers and duties as the Board of Supervisors may determine necessary to carry into effect the provisions of said article. The membership of the Agency consists of seven (7) persons, at least three (3) of whom shall be duly elected members of the Board of Supervisors, one (1) of whom shall be the Commissioner of Planning, and three (3) of whom shall be citizens of the United States residing in Erie County; all of whom shall be appointed by the County Executive of Erie County, and confirmed by the Board of Supervisors. A copy of Article 5 of the County Law is attached for your information.

In accordance with Section 11 D of EM 1165-2-111 we assure you that your information report will be publicized in the community and area concerned and that copies will be made available for open inspection by responsible interested parties and individuals.

Zoning and other regulatory, development and planning agencies and public information media, will be provided with the flood plain information for their guidance and appropriate action.

COPY

Survey markers, monuments, etc. established in any Federal surveys undertaken for Sec. 206 studies, or in regular surveys in the area concerned, will be preserved [illegible].

The Drainage Agency, at their meeting on October 6, 1961, resolved to make an applica-

FILE

A18

EXHIBIT A1

- -

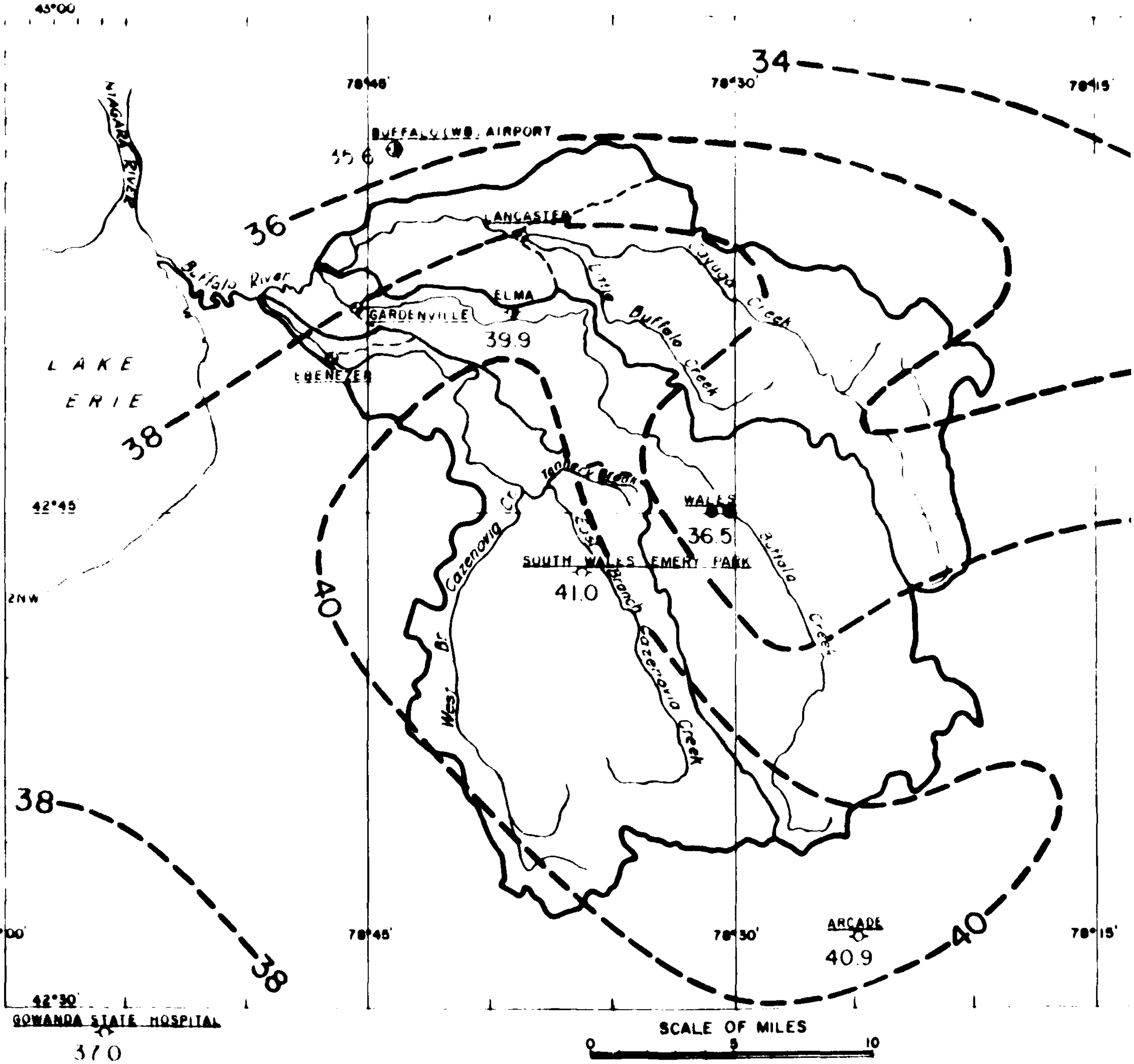
tion to your office for flood plain studies on Tonawanda, Ellicott, Cazenovia, Cayuga, Buffalo and Smokes Creeks. Mr. McKee suggested a separate letter on each creek and this letter, therefore, requests the studies on Buffalo Creek - Reach 1 - from its confluence with Cayuga Creek to the east line of the Town of West Seneca - Reach 2 - from the east line of West Seneca to the east line of the Town of Elma.

We will be glad to discuss this application further with the State of New York or with your office at any time.

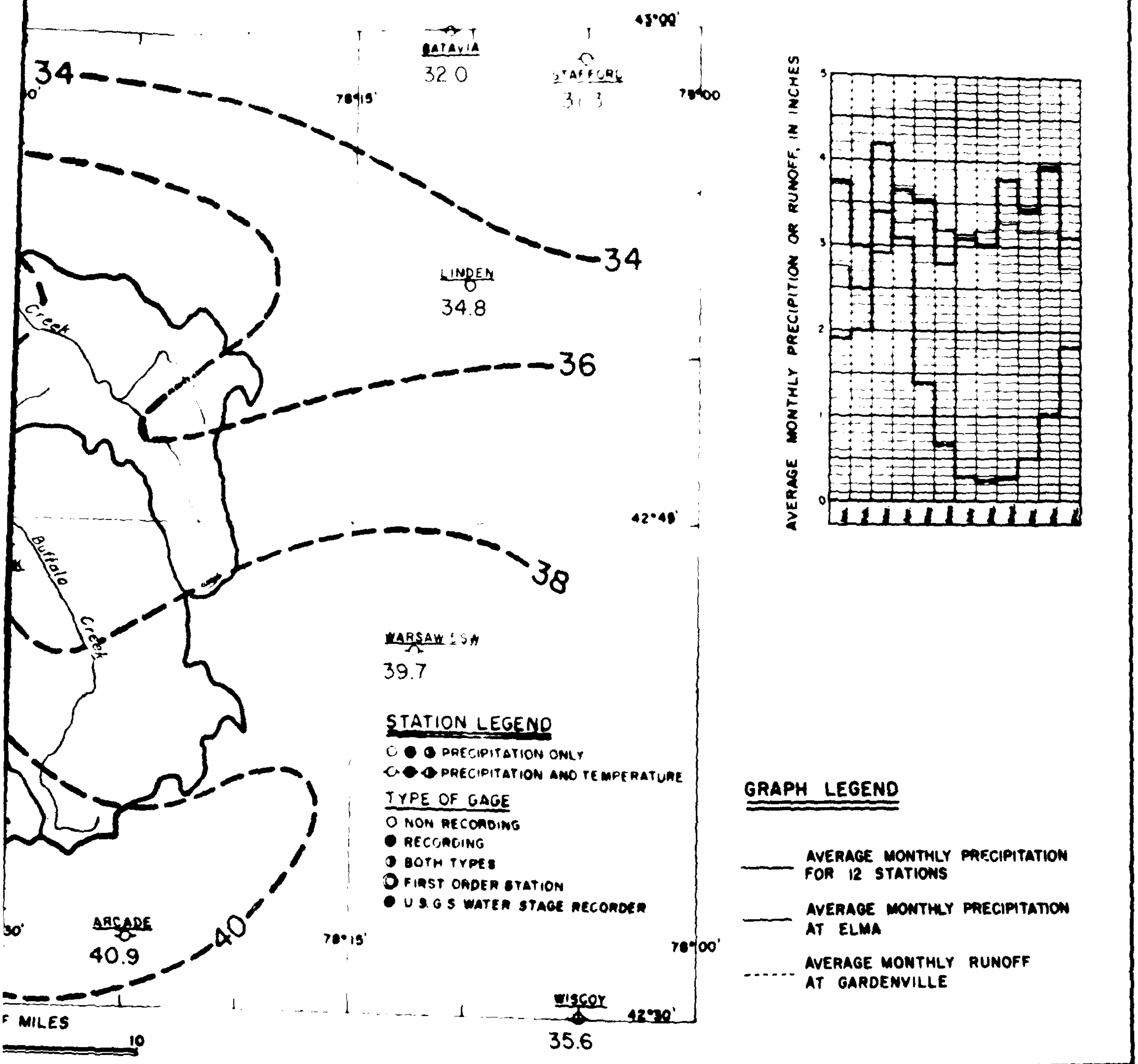
Very truly yours,

C. C. Spencer, P. E.
Deputy Commissioner

CCS:lm



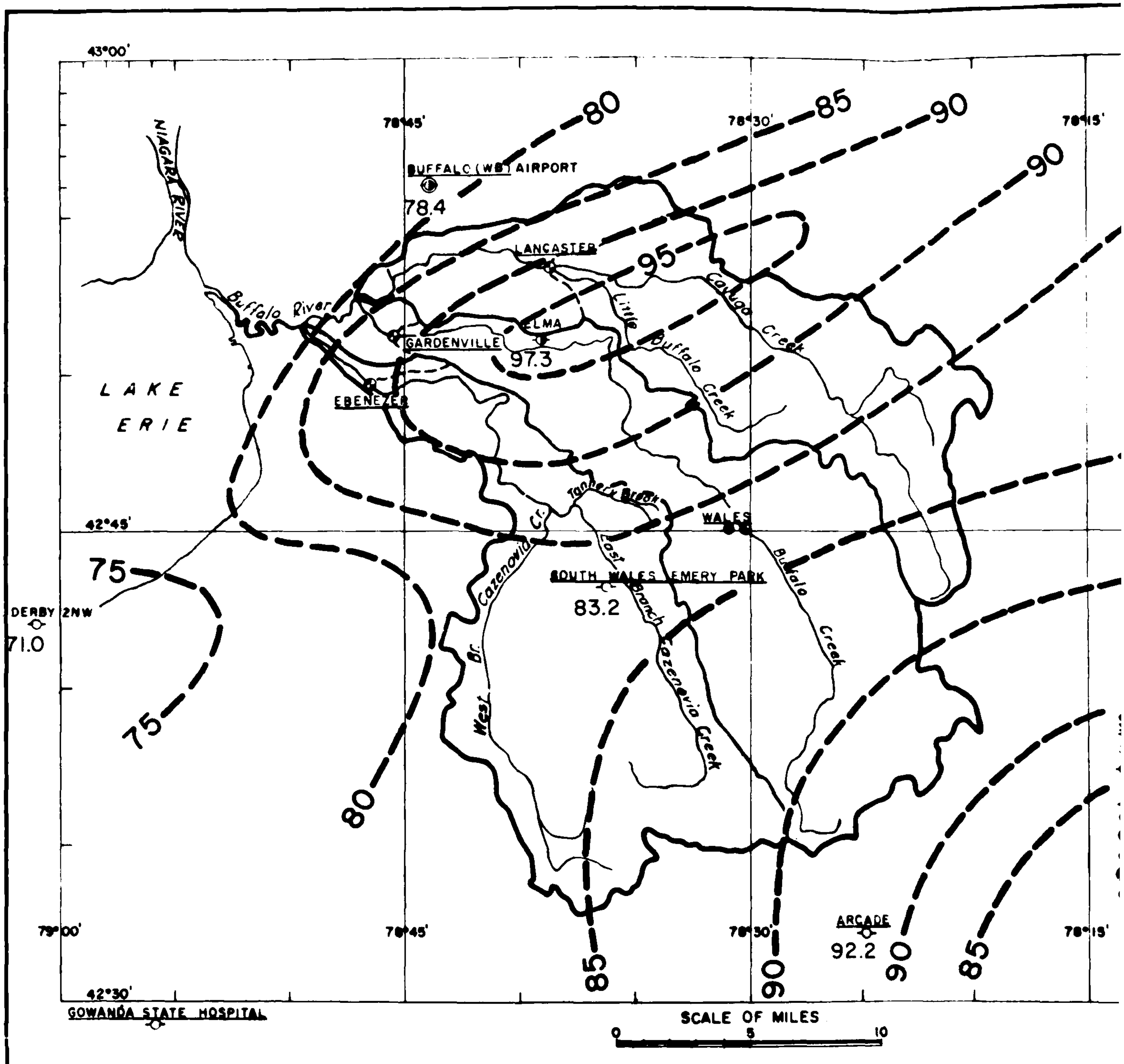
AVERAGE ANNUAL PRECIPITATION IN INCHES



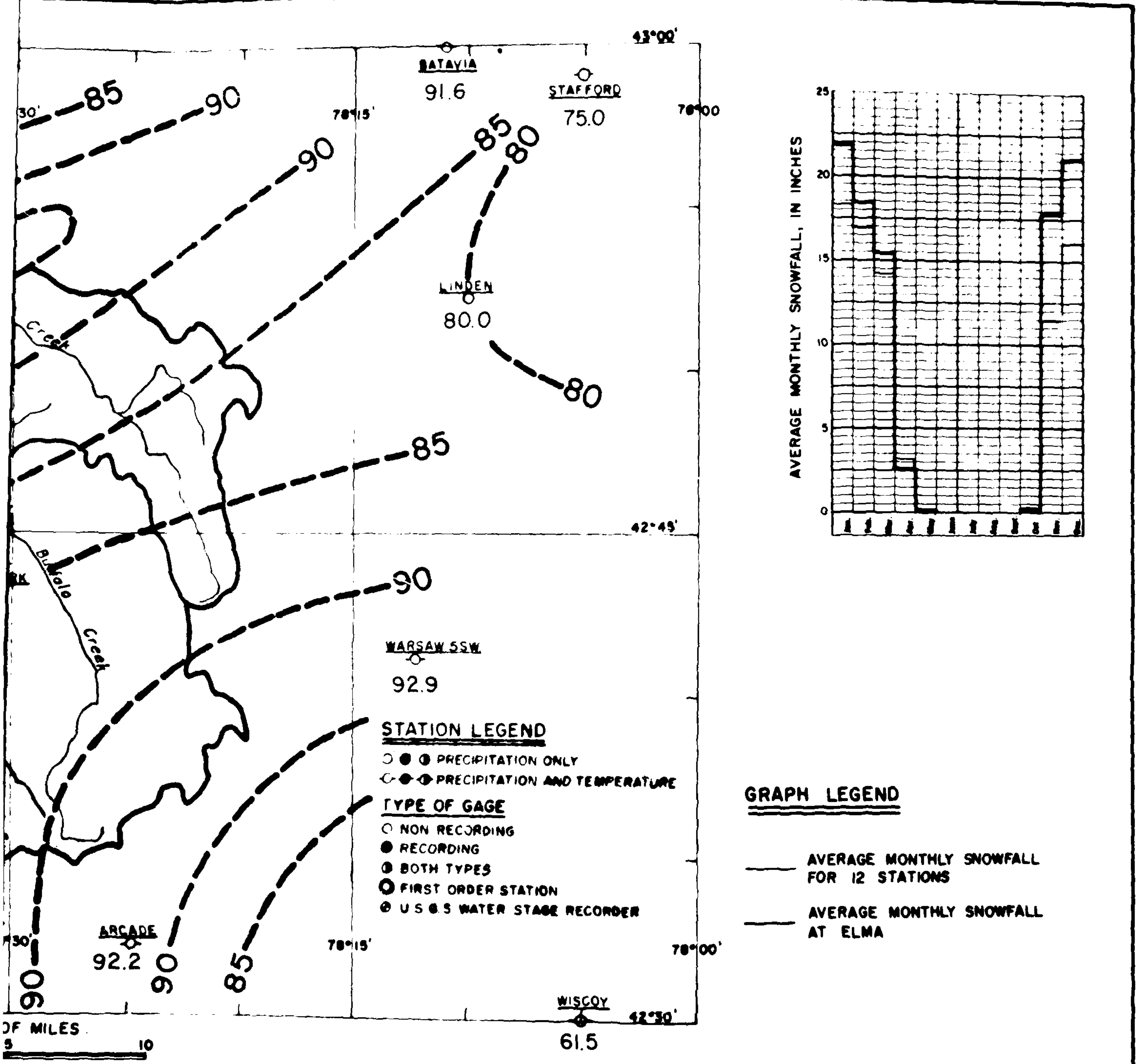
PITATION IN INCHES

FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA
HYDROLOGIC STATION AND PRECIPITATION MAP
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A1



AVERAGE ANNUAL SNOWFALL IN INCHES



)WFALL IN INCHES

FLOOD PLAIN STUDY

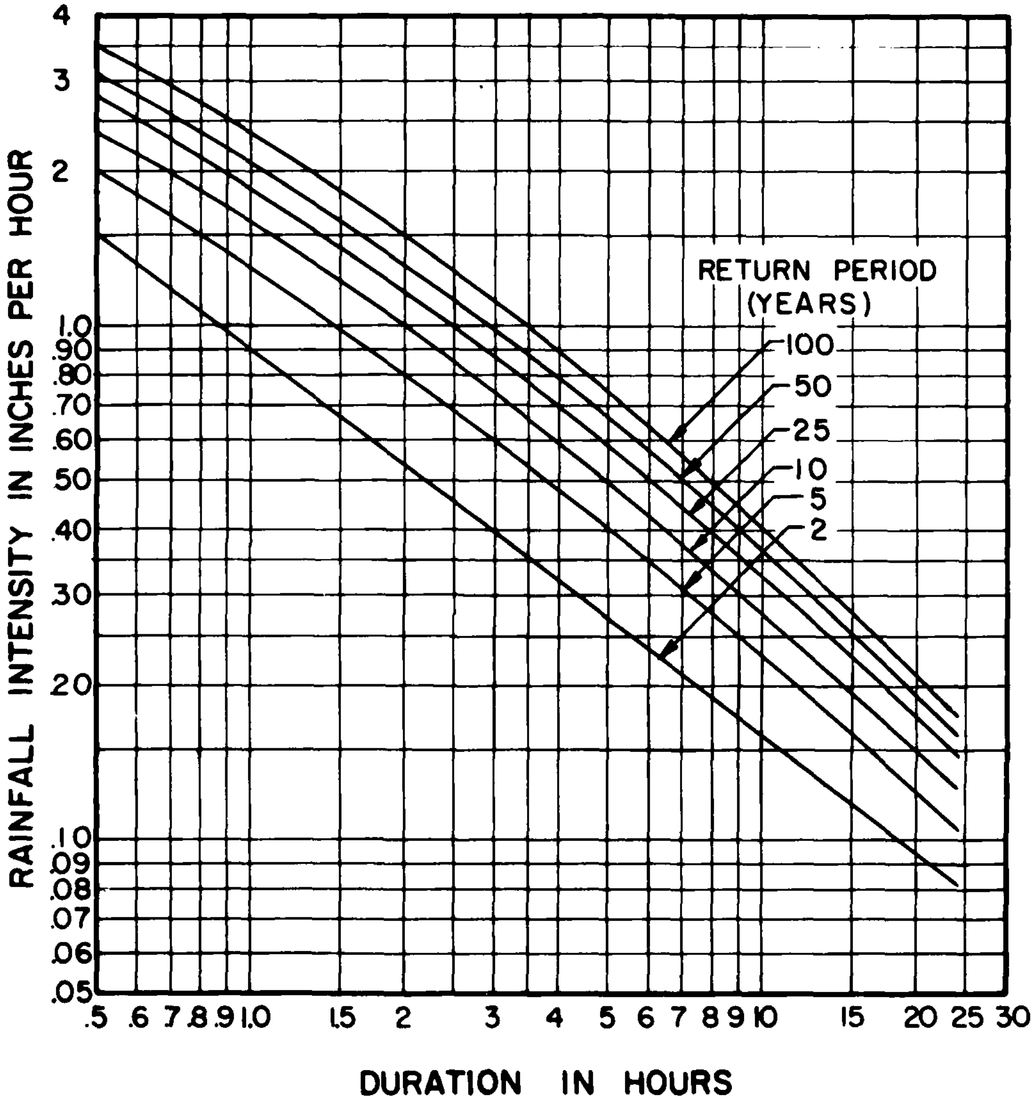
BUFFALO CREEK, NEW YORK

TOWNS OF ELMA AND WEST SENECA

SNOWFALL MAP

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A2



DERIVED FROM U.S. WEATHER BUREAU TECHNICAL PAPER NO. 40," RAINFALL FREQUENCY ATLAS OF THE UNITED STATES"

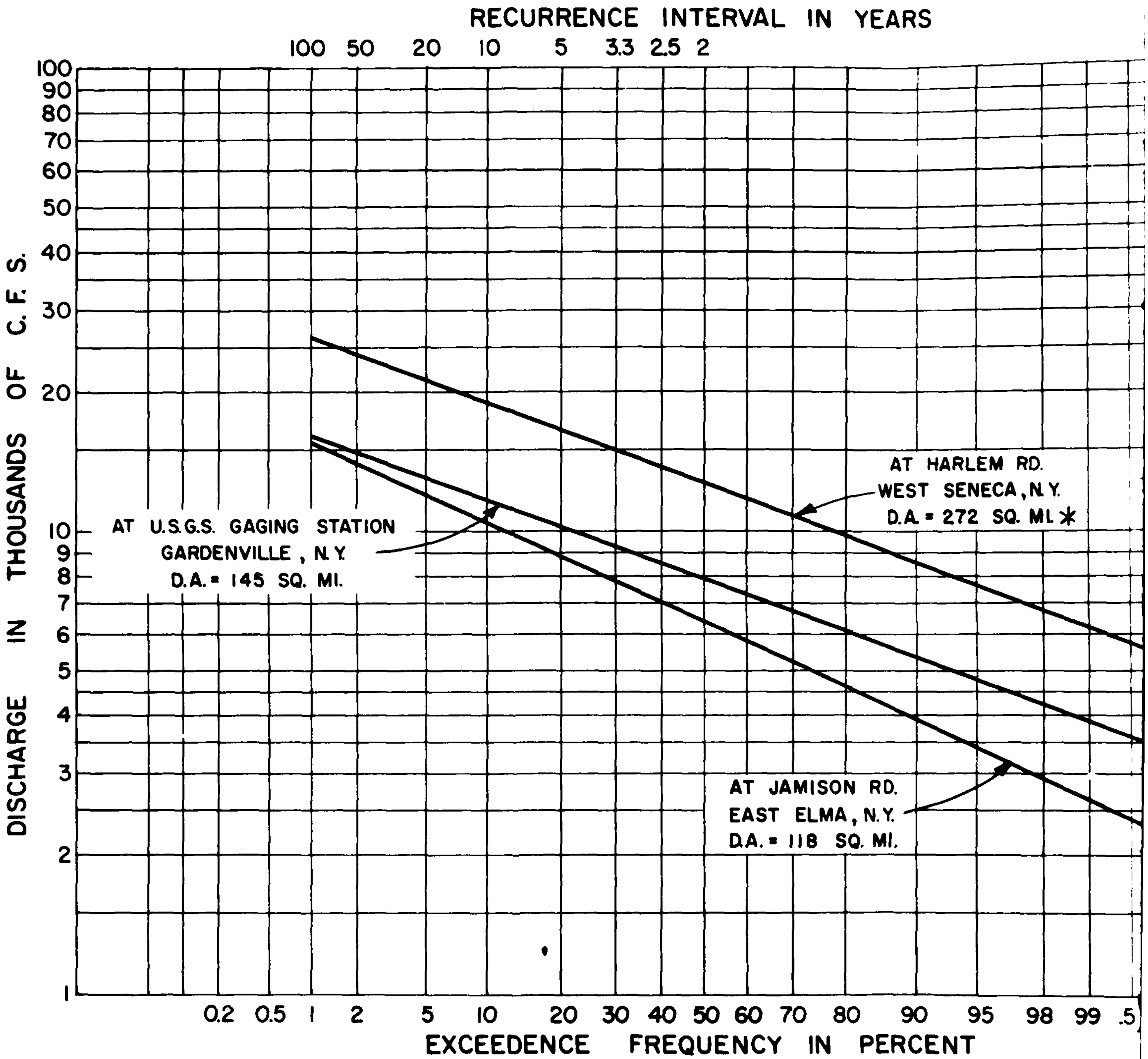
CURVES ARE APPLICABLE FOR ANY GIVEN POINT IN THE BUFFALO CREEK WATERSHED.

FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA

RAINFALL INTENSITY DURATION FREQUENCY CURVES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A3



* DRAINAGE AREA OF 272 SQUARE MILES AT HARLEM ROAD INCLUDES BUFFALO AND CAYUGA CREEKS.

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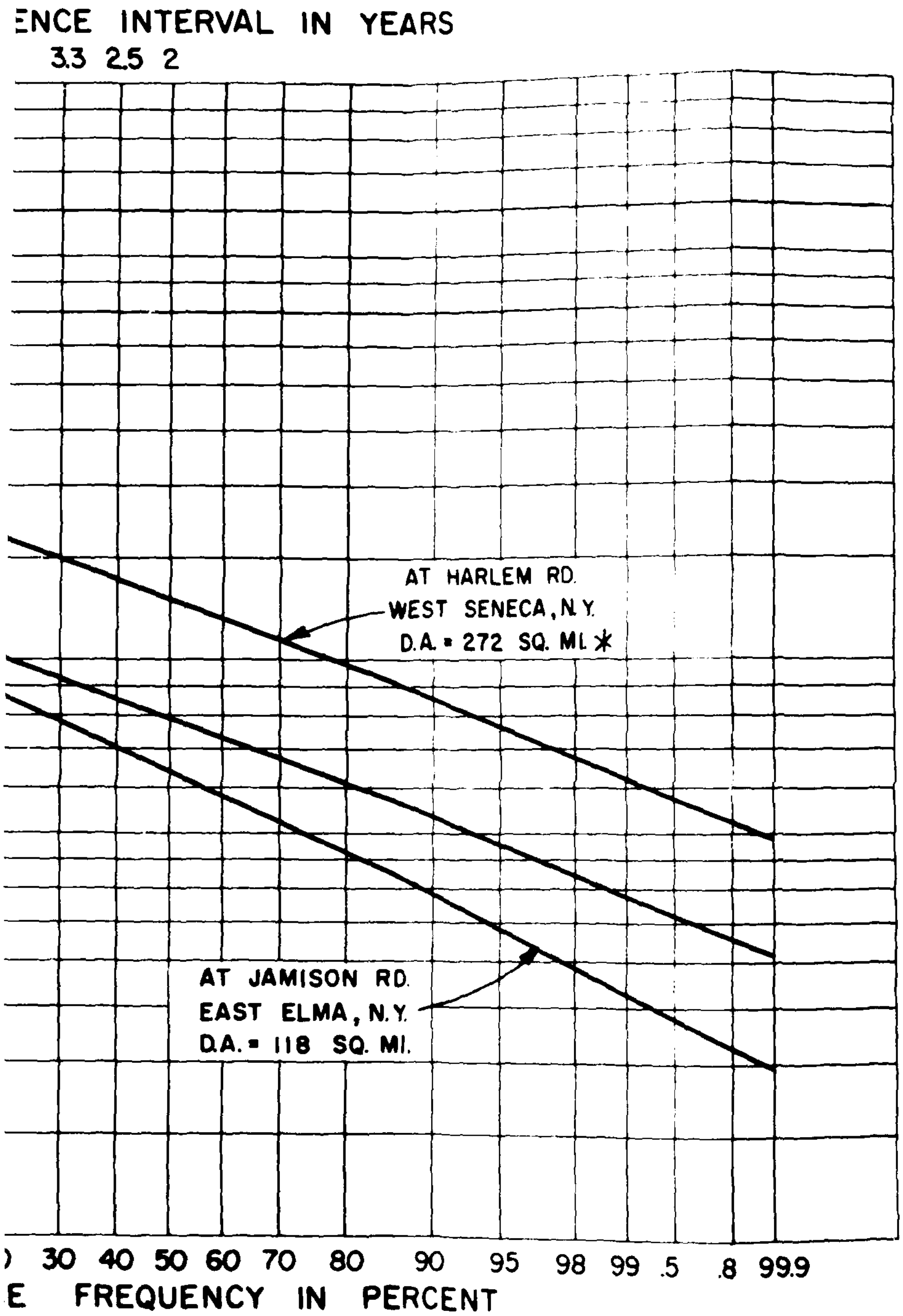
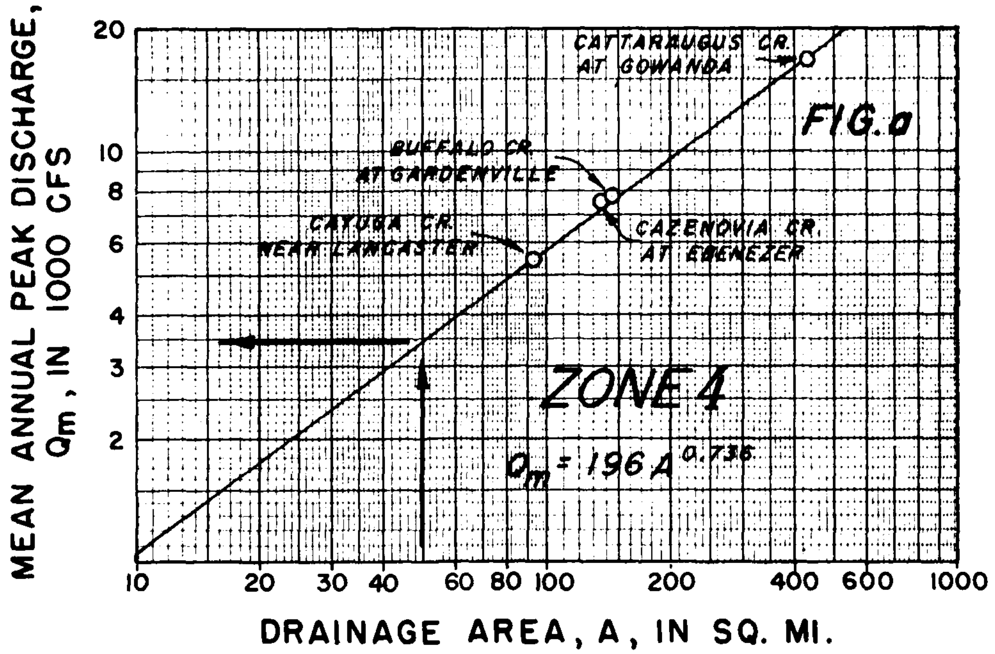
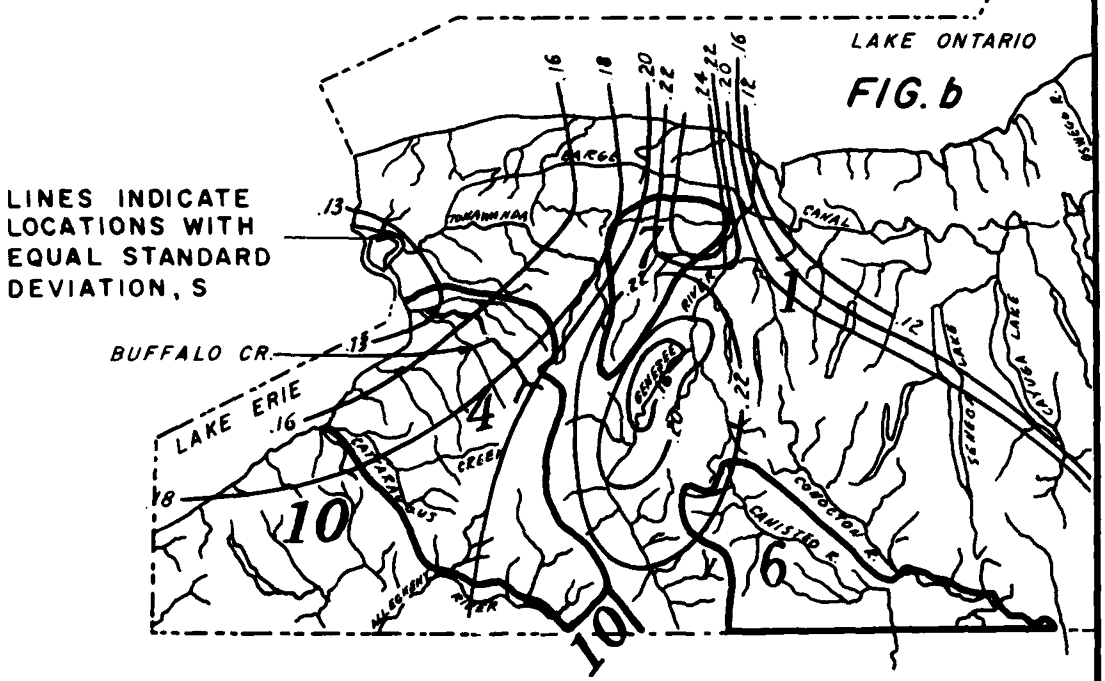


AT HARLEM ROAD
EKS.

FLOOD PLAIN STUDY
BUFFALO CREEK, NEW YORK
TOWNS OF ELMA AND WEST SENECA
DISCHARGE - FREQUENCY CURVES
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A4





1. ENTER FIG. a WITH DRAINAGE AREA ABOVE POINT OF INTEREST, READ Q_m.
2. ENTER FIG. b AT POINT ON STREAM, READ S.
3. $\text{LOG } Q_{15.9\%} = \text{LOG } Q_m + S$
4. $\text{LOG } Q_{84.1\%} = \text{LOG } Q_m - S$

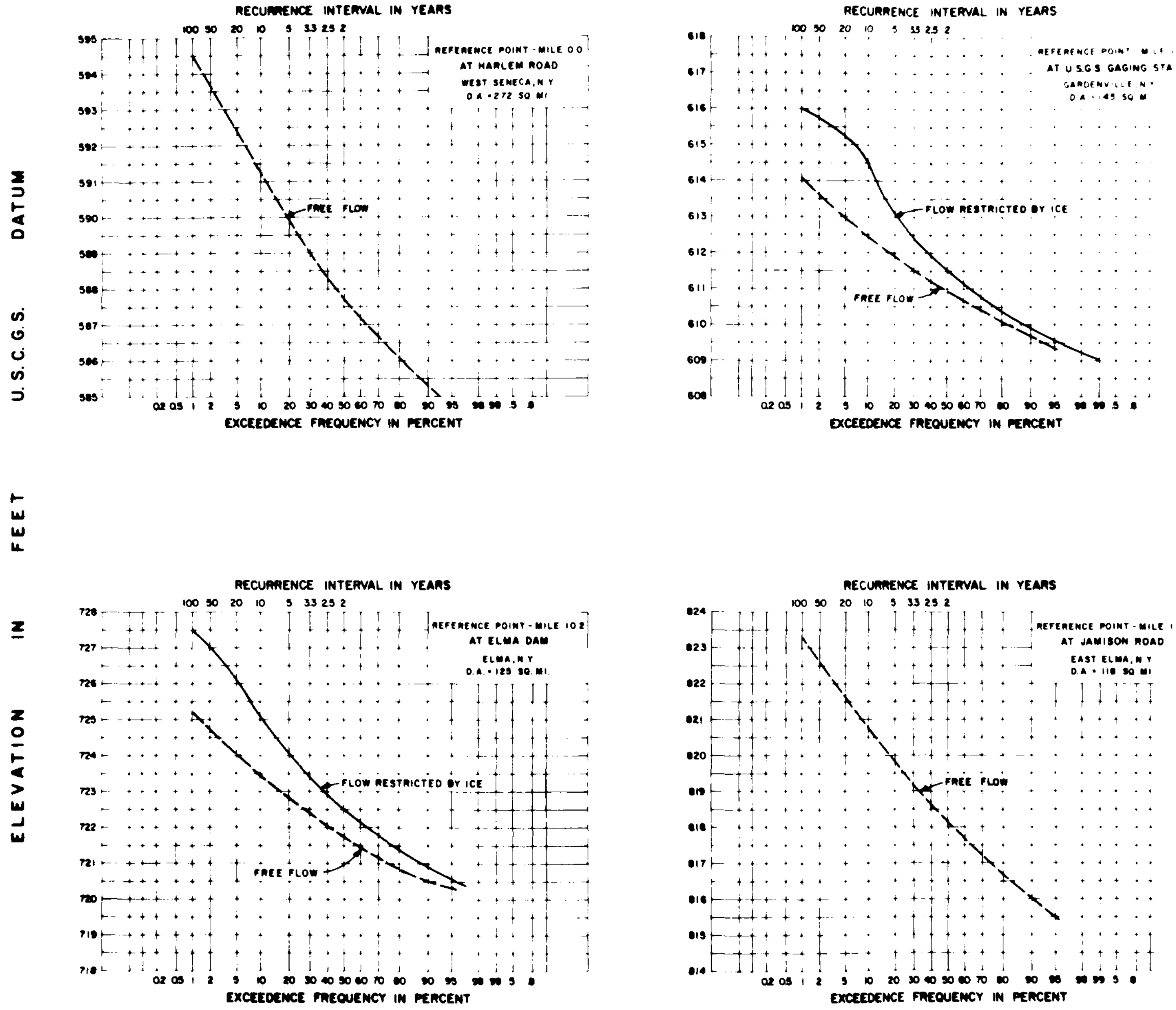
FLOOD PLAIN STUDY

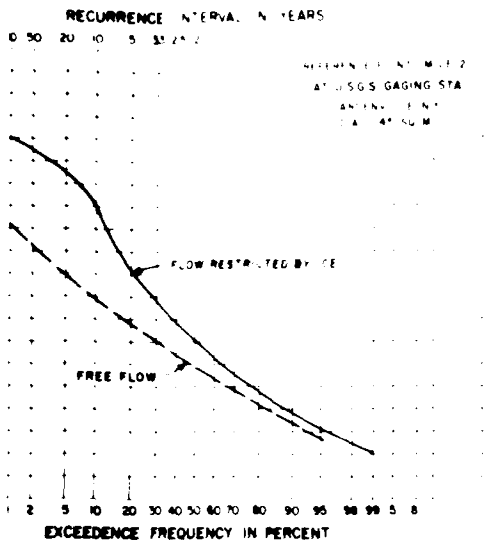
BUFFALO CREEK, NEW YORK

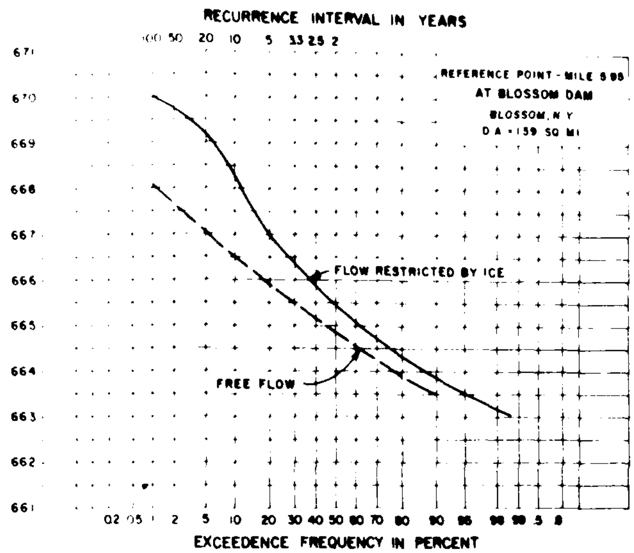
TOWNS OF ELMA AND WEST SENECA

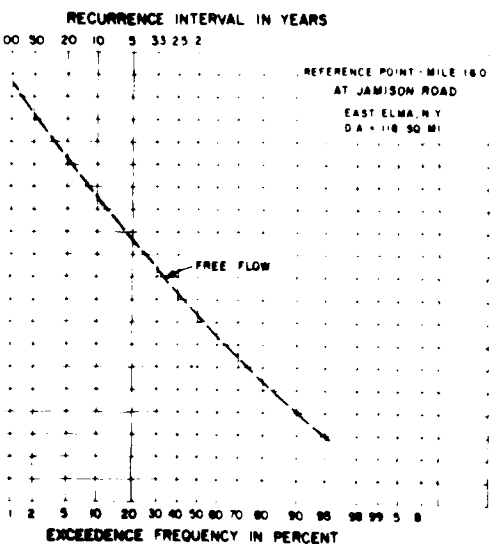
REGIONAL GENERALIZED DISCHARGE-FREQUENCY CURVES

U.S. ARMY ENGINEER DISTRICT, BUFFALO


ELEVATION IN FEET U.S.C.G.S. DATUM
RECURRENCE INTERVAL IN YEARS
100 50 20 10 5 3.3 2.5 2
REFERENCE POINT - MILE 0.0
AT HARLEM ROAD
WEST SENECA, N.Y.
D.A. = 272 SQ. MI.
FREE FLOW
0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 .5 .8
EXCEEDENCE FREQUENCY IN PERCENT
RECURRENCE INTERVAL IN YEARS
AT U.S.G.S. GAGING STA
FLOW RESTRICTED BY ICE
FREE FLOW
EXCEEDENCE FREQUENCY IN PERCENT
RECURRENCE INTERVAL IN YEARS
REFERENCE POINT - MILE 10.2
AT ELMA DAM
ELMA, N.Y.
D.A. = 125 SQ. MI.
FLOW RESTRICTED BY ICE
FREE FLOW
EXCEEDENCE FREQUENCY IN PERCENT
RECURRENCE INTERVAL IN YEARS
AT JAMISON ROAD
EAST ELMA, N.Y.
FREE FLOW
EXCEEDENCE FREQUENCY IN PERCENT







NOTE

WHERE ONLY ONE CURVE IS SHOWN AT A REFERENCE POINT IT WAS CONSIDERED THAT ICE HAS INSIGNIFICANT EFFECT ON THE STAGE FREQUENCY.

FLOOD PLAIN STUDY

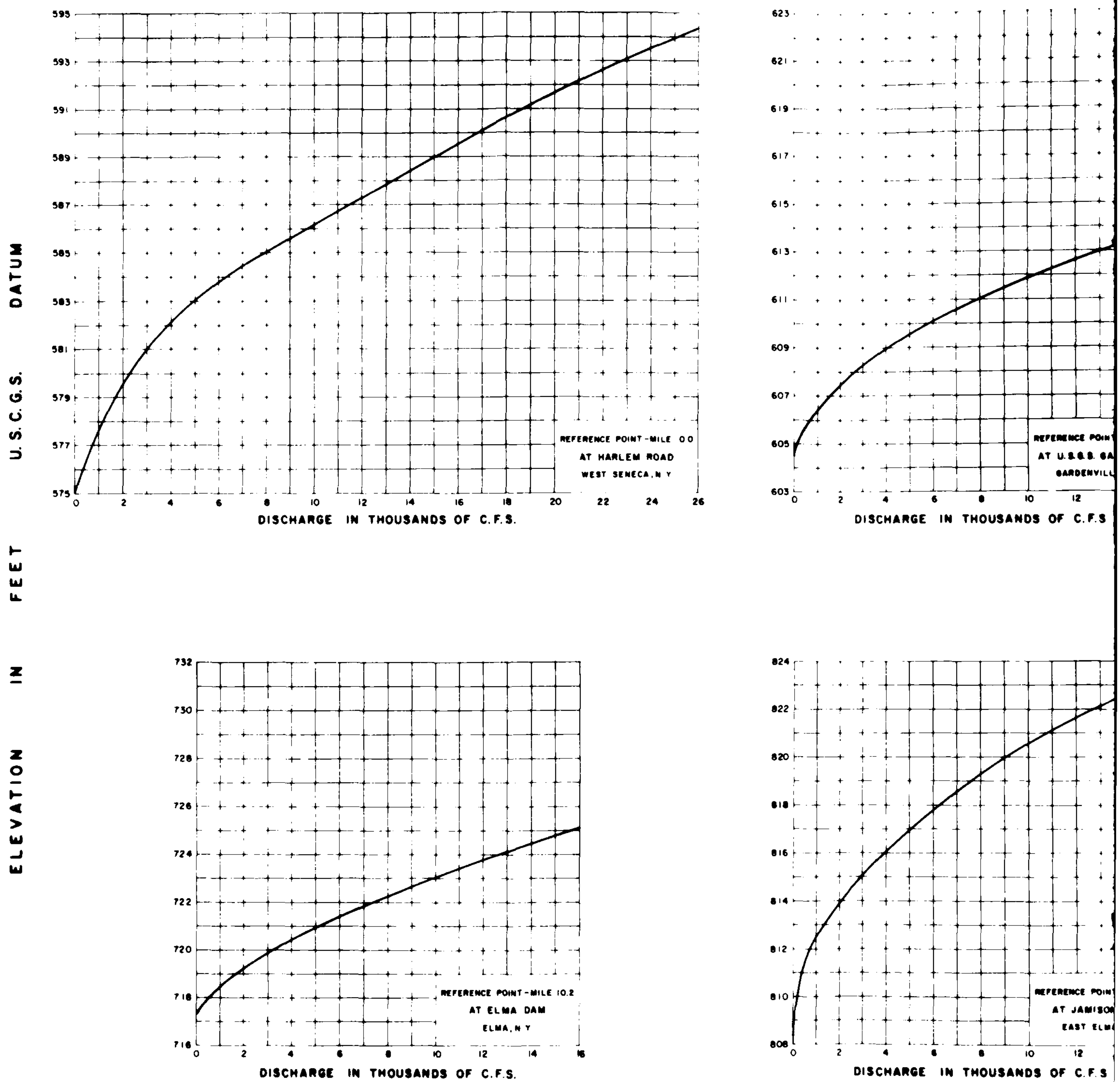
BUFFALO CREEK, NEW YORK

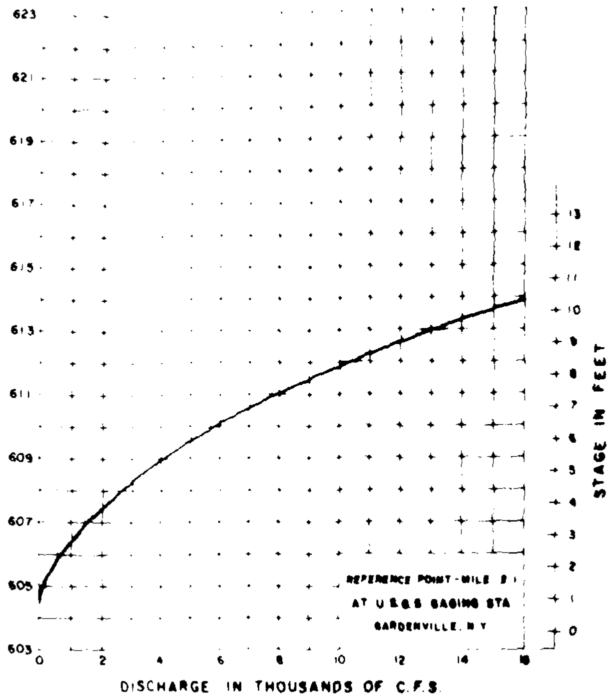
TOWNS OF ELMA AND WEST SENECA

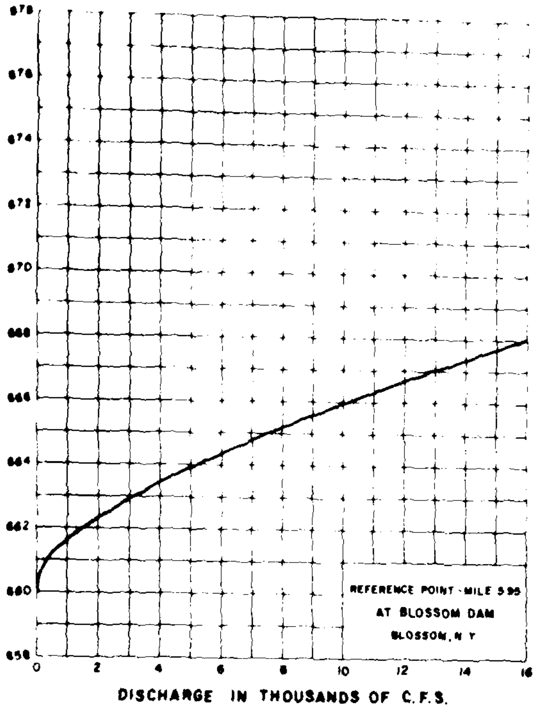
STAGE FREQUENCY CURVES

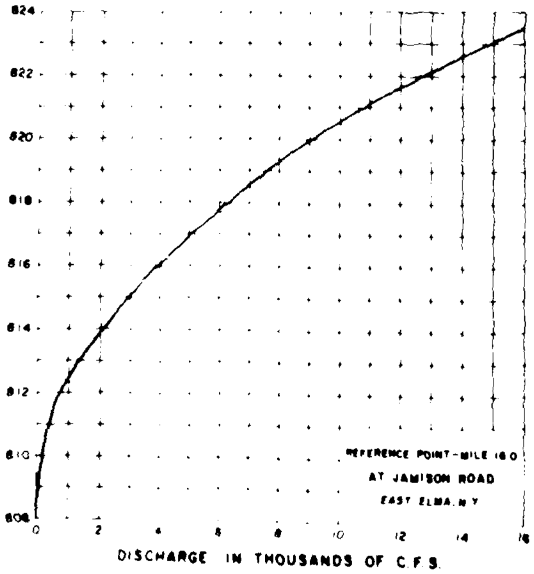
U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A6


ELEVATION IN FEET U.S.C.G.S. DATUM
REFERENCE POINT-MILE 0.0
AT HARLEM ROAD
WEST SENECA, N.Y.
DISCHARGE IN THOUSANDS OF C.F.S.
DISCHARGE IN THOUSANDS OF C.F.S
REFERENCE POINT-MILE 10.2
AT ELMA DAM
ELMA, N.Y.
DISCHARGE IN THOUSANDS OF C.F.S.
DISCHARGE IN THOUSANDS OF C.F.S







FLOOD PLAIN STUDY

BUFFALO CREEK, NEW YORK

TOWNS OF ELMA AND WEST SENECA

STAGE DISCHARGE CURVES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

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